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The Maryland Herpetological Society  
Department of Herpetology, Natural History Society of Maryland, Inc.

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## A New Subspecies of the Lizard *Sceloporus mucronatus* (Sauria, Phrynosomatidae)

Robert G. Webb, Julio A. Lemos-Espinal, and Hobart M. Smith

### Abstract

Specimens from the northwesternmost part of the range of *Sceloporus mucronatus* in the Mexican state of México are described as a new subspecies of *S. mucronatus*. Pattern and scalation features of the four recognized subspecies geographically segregate into two groups, each with two subspecies—one including the new taxon and nominotypical *S. mucronatus*, the other *S. m. omiltemanus* and *S. m. aureolus*.

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Olson (1998) commented on specimens from near Huichapán, Hidalgo, Mexico, suggesting a subspecific relationship of *S. mucronatus* and *S. poinsettii*. Auth et al. (2000) employed name-combinations reflecting this relationship. Earlier, Mindell et al. (1989:61) used a specimen identified as *S. poinsettii* from Hidalgo, Mexico (BYU 38634, "Esc. Conalep, Pachuca") as a voucher for allozyme studies.

The northwesternmost populations of *S. mucronatus* have some pattern features that obtain in *S. poinsettii* (expressed in varying degrees, may be geographically variable). Range-wide variation in numbers of dorsal scales and femoral pores of *S. mucronatus* is encumbered by that known for *S. poinsettii* (personal data, RGW). Scalation of the posterior frontal-frontoparietal area is often irregular in *S. poinsettii* (not in *S. mucronatus*). Pattern features shared by both species include (1) black and white tail bands (consistent and distally under tail in *poinsettii*, distinctness variable and usually absent under tail in *mucronatus*), (2) pale intertympanic band, (3) pale scale in black collar above shoulder, (4) juvenile throat pattern with pale, dark-bordered, median streak, (5) large females with blue belly patches, and (6) vertebral, dark-blotched dorsal body pattern (usually only males in some *poinsettii* populations). Black longitudinal lines on the back (*S. mucronatus aureolus*) may occur in specimens of *S. poinsettii*. Geographically, the two species (*poinsettii* and *mucronatus*) are widely separated; the southernmost known localities in central and eastern Mexico of *S. poinsettii* are 32 km (Hwy 45) NW Fresnillo, Zacatecas (UTEP

6179) and 2 km NW Concepción del Oro, Zacatecas (Ralph W. Axtell 6170), which are, respectively, about 485 air km NW and 525 air km NNW of the nearest, northernmost localities for *S. mucronatus* (Huichapán area, Hidalgo).

A series of 32 specimens from four different sites in Edo. de México differ from *S. m. mucronatus* in average size of dorsal scales and aspects of dorsal color pattern. These characters suggest a new taxon (described herein), having close taxonomic affinity with nominotypical *S. m. mucronatus* (see Comparisons and Key). The Mindell et al. (1989) specimen (see above) probably is representative of *S. m. mucronatus*; however the specimen (BYU 38634, Escuela Conalep, ca 1.0 km E Pachuca) cannot be located (Jack W. Sites, in litt. to RGW, 11 January 2001). Museum codes used in the text to designate specimen repository are BYU (Brigham Young University), UBIPRO (Unidad de Biotecnología y Prototipos, Esc. Nac. Estud. Prof. Iztacala, UNAM), UCM (University of Colorado Museum), and UTEP (University of Texas at El Paso).

*Sceloporus mucronatus olsoni* nov. subsp.

*Type material* (all Edo. México, México, collected by Julio Lemos-Espinal). Holotype, adult female, UCM 61083 (JLE 4503), San Juan Acazuchitlán [GPS 20°08'3.3"N, 99°36'15.8"W], 2646 m, 6 May 2000. Thirty-one paratypes: UBIPRO 4504, 4506, 5000, 5006, 5008, 5012-13, 5017, 5020; UCM 61082, 61084-92; UTEP 18566-69 (23 paratopotypes, same collection data as holotype); UBIPRO 8557-59, UTEP 18571-73, San Miguel at Km 99.5 (Hwy 57) [GPS 20°02'28.9"N, 99°34'26.9"W], 2533 m, 28 May 2000; UBIPRO 8560, Hwy 57 at Km 104.6 [20°04'24.0"N, 99°36'38.2"W], 2621 m, 28 May 2000; UTEP 18570, Km 113.4 (Hwy 57) [GPS 20°05'36.3"N, 99°41'26.3"W], 2609 m, 21 May 2000.

*Description of holotype.* The top of the head is mostly black with an indistinct pale intertympanic band (indicated by three spots), and a black collar 2-3 scales wide (with three included pale scales) having uninterrupted anterior and posterior whitish borders, each about two scales wide. The distinct dorsal body pattern consists of a vertebral black area (fading posteriorly) with scattered whitish spots. The sides of the body are pale brownish and patternless. The dorsal pattern of the holotype is illustrated in Fig. 1. The underside of the head has a diffuse blue and white mottled pattern, and a prominent midventral, longitudinal pale (and dark-bordered) streak. The black collar encroaches laterally onto the chest region. Enlarged blue-black groin patches are attenuated anteriorly to just behind the axillary region, and separated medially (midbody) by 7-8 scales.



The holotype, SVL 90 mm with incomplete tail (partly severed distally), has 34 dorsal scales, 41 scales around midbody, 12-13 femoral pores (series separated medially by about 13 scales), an entire anterior frontal, 1-1 frontoparietals separated by an azygous scale, the prefrontals in medial contact, 2-2 canthals, 1-1 loreals, 1-1 preoculars, and the anteriormost sublabials (labiomentals) not contacting the mental.

*Diagnosis.* A subspecies of *Sceloporus mucronatus* distinguished from *S. m. aureolus* and *S. m. omiltemanus* in adults having a dorsal pattern of black vertebral blotches, and from *S. m. mucronatus* in adults having a reddish color in life and smaller dorsal scales (see Comparisons and Key); *S. m. mucronatus* and *S. m. olsoni* also occupy distinctive habitats.

*Description.* Adults of both sexes have a pronounced reddish color in life (fading in preservative), which may vary in intensity and reflect breeding condition (specimens collected 6, 21 and 28 May), and is absent in lizards less than about 70 mm SVL (JLE). The dorsal surface of the head (large-scaled part) is dark brown to black, paler posteriorly, patternless, but may have tiny whitish flecks (three dots across parietals most consistent). A pale intertympanic band is usually faded and indistinct (absent or nearly so in UBIPRO 5013, UCM 61087, UTEP 18566; most distinct in UBIPRO 8560). The uninterrupted, black collar (about 3-4 scales wide) has white anterior and posterior borders two scales wide (both anterior and posterior borders may be narrowly interrupted medially). A pale scale(s) may occur within the black collar above the shoulder (UTEP 18571). The vertebral area between the collar and intertympanic band usually is darker than laterally. The basic dorsal body pattern in adults of both sexes is a dark (black) vertebral area that is interrupted by pale transverse solid bars or series of spots to form dark vertebral blotches; the sides of the body are mostly uniformly pale brownish, but may have some pale scales (e.g., UTEP 18572). Small specimens 54 and 40 mm SVL (UTEP 4580-81, regarded as intergradient, see comments under *S. m. mucronatus*) have indistinct vertebral dark areas with prominent white spots oriented transversely and in dorsolateral rows; the smallest has indistinct whitish postocular marks. Blotched patterns become more distinct with increasing size. Adult females have a distinct pattern of either dark vertebral blotches separated by solid bars, or a mostly continuous black vertebral area (less well-defined blotches) with intervening white marks staggered and interrupted (two females in Fig. 1). Patterns may be faded/indistinct in both sexes of large adults (female, UTEP 18570, 70 mm SVL, and two males in Fig.



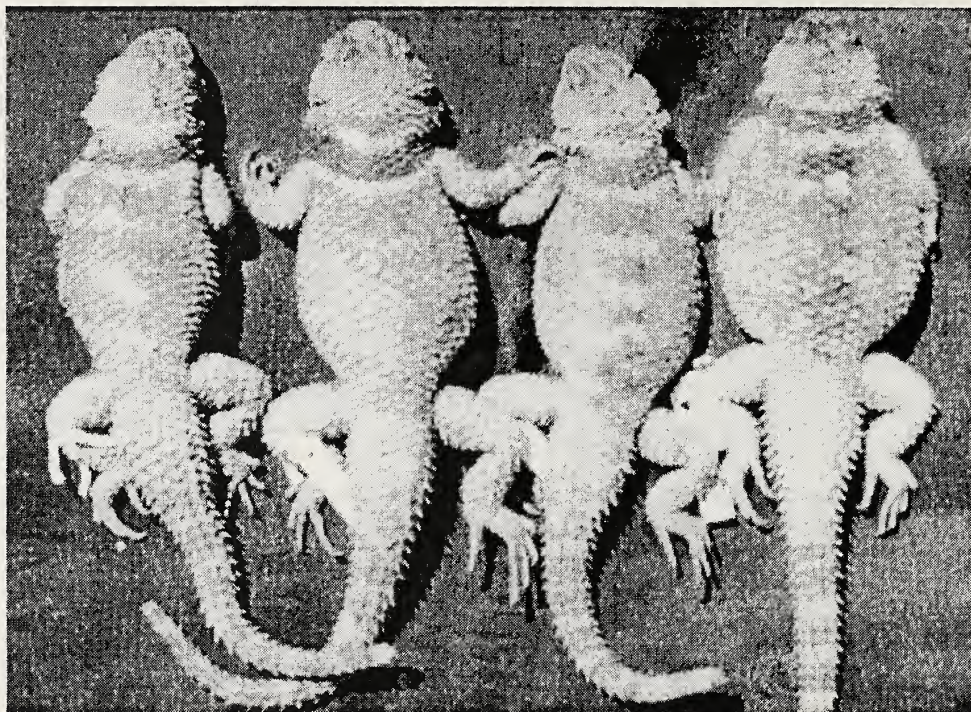


Fig. 1. *Sceloporus mucronatus olsoni* from Edo. de México (type-material, see text). Left to right: UTEP 18571, male, 90 mm SVL; UBIPRO 8559, male, 94 mm SVL; UBIPRO 8560, female, 91 mm SVL; UCM 61083 (holotype), female, 90 mm SVL.

1). Tails are banded black (widest) and whitish (only about one scale wide), but the degree of contrast is variable; the underside of tails (reddish in life, JLE) is usually immaculate (indistinct distal dark banding in UBIPRO 5000, 5008; UCM 61086, 61090; UTEP 18569). The juvenile throat pattern (both sexes) consists of a coarse dark blue, irregular barring with a dark-bordered, pale longitudinal median streak; this pattern generally persists in large females (lateral dark barring diffuse, mostly pale-dark mottling but with evidence of pale median streak), but is more diffuse and bluish in large males and mostly uniform blue in the largest males (UTEP 18571, SVL 90 mm). In large males, the black collar is mostly continuous across the throat, blackish marks occur on the chest, and black groin patches extend anteriorly as medial borders of the blue belly patches (separated medially 5-8 scales); black markings may occur midventrally. Large females (lacking enlarged postanal pair of scales)



have the same basic ventral body pattern as males (variable in females but rather distinct dark-bordered blue belly patches), except for lack of black marks midventrally, and black across throat (diffuse, incomplete).

Males may attain a slightly larger size than females; the largest male is about 94 mm SVL (UBIPRO 8559), female 91 mm SVL (UBIPRO 8560). There are usually two canthals, one loreal, and one preocular (some minor variation), and some head scale anomalies (e.g., left prefrontal and anterior frontal fused, UBIPRO 4504; the anterior frontal one-half divided, UBIPRO 5008). Dorsal scales average 34.3 (31-37,  $n = 31$ ), scales around midbody 38.8 (34-43,  $n = 31$ ), and femoral pores 13.5 (11-15,  $n = 62$ , one leg) or 26.9 (23-30,  $n = 31$ , both legs); the pore series are separated medially by about 11 scales (10.8, 9-13,  $n = 31$ ). The anterior frontal is entire (61%,  $n = 31$ ), and there is usually one frontoparietal (82%,  $n = 62$ , both sides of head) separated by an azygous scale (frontoparietals in medial contact in 5, separated [no azygous scale] in 2 of 62).

*Distribution.* *Sceloporus m. olsoni* occurs in the northwestern part of the range of the species in the Mexican state of México (along Hwy 57); see map, Fig. 2. Lizards from the type locality were in rock crevices in a low density oak forest. The general habitat (JLE) is a semiarid, flat area with rocky hills and many oaks, *Acacia*, and *Prosopis*; the elevational range is 2533-2646 m (8308-8679 ft, four localities). *Sceloporus torquatus* is sympatric (syntopic) with *S. m. olsoni*; *S. torquatus* prefers rock fences and large boulders, whereas *S. m. olsoni* occurs in cracks of small rocks near the ground (JLE).

### Description of *Sceloporus mucronatus*

*Sceloporus mucronatus* is of moderate size with males slightly larger than females; Smith et al. (1952) recorded the maximal size (presumably male) as 114 mm SVL. The supraoculars are divided, prefrontals usually in medial contact, anterior frontal usually entire (not longitudinally divided), frontoparietals usually 1-1 separated by an azygous scale, and canthals usually 2-2, loreals 1-1, and preoculars 1-1; the anteriormost sublabial (labiomen-tal) rarely contacts the mental. The femoral pore series are widely separated medially (average about 11-12 scales). Black collars are distinct, unbroken, with the pale borders usually about two scales wide (rarely one) and entire (both or only the anterior border may be narrowly interrupted medially). Blue belly patches are rather widely separated (about 6-8 scales at midbody), with the largest adult males having solid blue throats and black in chest region and midventrally.

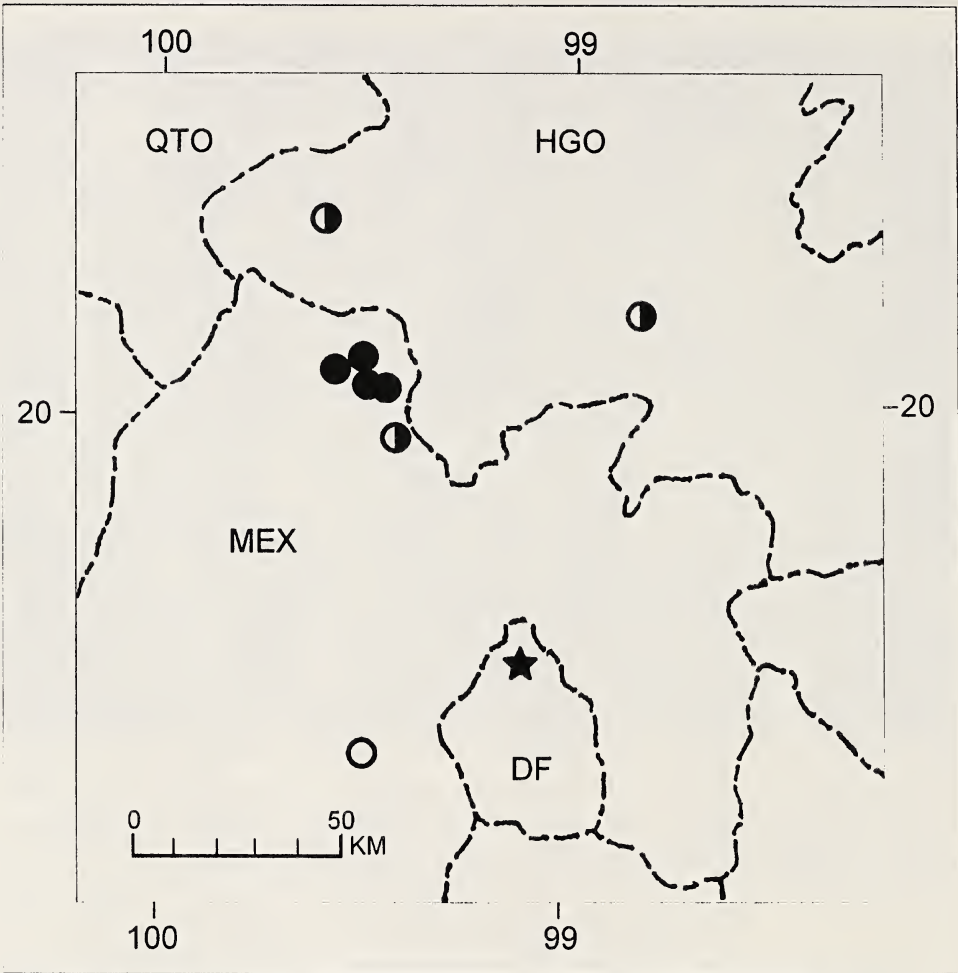


Fig. 2. Map of Mexico City (star) area and adjacent states showing localities for *Sceloporus mucronatus olsoni* (solid circles), presumed intergrades, *S. m. olsoni* x *S. m. mucronatus* (half-solid circles—SW Huichipán and NW Pachuca, Hgo, and Jilotepec, Méx), and our large sample of *S. m. mucronatus* (open circle—Km 19, Hwy 894, Méx). Alvarez and Huerta (1973) mapped the Pachuca and Jilotepec sites (see text) and other known localities for *S. mucronatus*.

Numbers of dorsal scales and femoral pores, and aspects of dorsal and ventral patterns have some taxonomic utility. Dorsal body patterns consist of either a black vertebral area/blotches, or black-edged scales/longitudinal lines on the body. A pale intertympanic band (transverse series of pale scales between ear openings; postoccipital band of Olson, 1998) is present or absent,



and the black collar varies in width (with or without an enclosed pale scale above shoulder). Tails (usually immaculate ventrally-distally) have distinct or indistinct black (widest) and whitish (one or two scales wide) banded patterns. The juvenile throat pattern (usually dimly barred or mottled) with a pale, dark-bordered, median streak (= parallel, longitudinal dark lines on middle of throat in Smith, 1942:357) is present or absent. Adult females (no enlarged pair of postanal scales) may have either a whitish venter with only a pale blue suffusion, or rather distinct blue, black-bordered belly patches (but little or no dark pigment on chest or midventrally).

Three subspecies of *Sceloporus mucronatus* have been recognized, two (*mucronatus* and *omiltemanus*) by Smith ("1936"[1938], 1939) and a third (*aureolus*) later described by Smith (1942). Alvarez and Huerta (1973) recognized these three subspecies in their review of *S. mucronatus*. Individuals generally occur on rocks or logs at relatively high elevations in oak or pine-oak forests. Data for these three subspecies, derived from some additional specimens and published reports, are discussed below.

*Sceloporus m. mucronatus*. Our material consists of 64 specimens (UBIPRO 5, 7-8, 30, 33-34, 39, 41, 44, 151, 163, 169, 232, 285-86, 305-06, 2237-38, 2240, 2244-45, 2250, 2254, 2256-57; UCM 61093-114, 61116; UTEP 18574-88) all from one locality, Edo. de México, Km 19 on Hwy 894 (between Ajusco and Tianguistenco), 3400 m. The cold-weather collection site is a pine forest (*Pinus montezumae* and *P. hartwegii*) with some grassland (*Festuca* and *Muhlenbergia*); lizards were taken in an open grassy area among basaltic rocks (JLE).

Heads are dark grayish to blackish, unpatterned. The pale intertympanic band is usually indistinct (distinct spots [UCM 61100] or small dots [UTEP 18576]) but may be absent. Black collars are about four scales wide and usually lack pale scales above the shoulder (distinct in UCM 61093, indistinct both sides in UBIPRO 5, 41). The dorsal pattern consists of a black vertebral area (several discrete dark spots, UCM 61107, 73 mm SVL; four dark crossbands separated by whitish marks, UTEP 18582, 62 mm SVL, both females) that is mostly continuous but with some scattered white spots-marks transversely oriented to form black blotches; the black vertebral area is faded, indistinct in a large male (UCM 61094, 98 mm SVL). Pale brownish sides of the body are mostly unmarked or with some slightly paler scales. Tails are moderately banded (rather distinct in UBIPRO 30, 33, 39; UCM 61096). Juvenile throat patterns (pale medial streak) are present (diffuse or absent in adults). Adult females (no enlarged postanal scales) may have moderately distinct

belly patches and mostly uniform dark throats (e.g., UTEP 18583, 91 mm SVL; UTEP 18584, 72 mm SVL; UBIPRO 2254, 84 mm SVL; UTEP 18586-87, 83 and 76 mm SVL) and may have some black on chest (UBIPRO 2254, UTEP 18583). Large adult males have solid blue throats, with black complete across the throat; chest and midventral areas may be uniformly dark gray to almost black (UBIPRO 41, UTEP 18578, ca 100 and 95 mm SVL). Dorsal scales average 30.0 (27-34,  $n = 63$ ), midbody scales 40.0 (37-43), and femoral pores 12.0 (10-15,  $n = 116$ , one leg) or 24.0 (20-29,  $n = 55$ , both legs).

Smith's "Diagnosis" of *S. m. mucronatus* ("1936"[1938]:583-584, and Fig. 10 [side and dorsal head scalation]) is repeated (only slight changes) in Smith (1939:218-220, and Fig. 26). Smith ("1936"[1938]:Pl. XLIX, Fig. 2) illustrated the dorsal pattern of a Veracruz female. Smith (1942) noted dorsal scales averaging 29.6 (27-32,  $n = 49$ , 93.6% 31 or less) and femoral pores 12.8 (10-17,  $n = 94$ ). Smith and Laufe (1945) recorded femoral pores averaging 12.0 (10-14,  $n = 35$ ). Smith et al. (1952, vicinity Las Vigas, Veracruz) noted 10-13 femoral pores per side, dorsal scales 27-29, and black collars covering about 3-4 scales.

Alvarez and Huerta (1973, Table 1, combined data for seven localities) noted dorsal scale averages of 29.3-32.4 (27-38) and femoral pores 10.9-15.4 (9-16). However, two of their samples may reflect intergradation with *S. m. olsoni* (see below); excluding these two samples, five of their samples of *S. m. mucronatus* have combined dorsal scale averages of 29.3-31.7 (27-34), but the same variation in femoral pores. Thus *S. m. mucronatus* (above data combined and including the five samples of Alvarez and Huerta) has larger dorsal scales (averaging about 29-31, 27-34) than *S. m. olsoni* (34.3, 31-37).

Two samples of Alvarez and Huerta (1973, Table 1), Pachuca, Hidalgo, and Xilotepec [= Jilotepec], Mexico (combined femoral pores 11.9-12.1, 11-15), have the highest counts and averages of dorsal scales (respectively, 32.4, 29-38,  $n = 20$  and 32.4, 29-35,  $n = 11$ ), and are perhaps intergradient. The Pachuca and Jilotepec samples are geographically nearest to the *olsoni* localities; the former site (recorded as 14 or 15 km W Pachuca, Alvarez and Huerta, 1973:180, 182, and presumably along Highway 85 northwest of city) is some 70 air kilometers distant, whereas the latter site (= Xilotepec or Xlotepec in Alvarez and Huerta, 1973:179, 182) is only some 10-20 air kilometers south-southeast, of the *olsoni* sites along Hwy 57. Six additional specimens from Edo. de Hidalgo are judged to be intergradient between *S. m. olsoni* and *S. m. mucronatus* (REO 5862-64, 5874, 6.7 mi SW Huichapán, Olson, 1998, and UTEP 4580-81, 10.9 road mi [Hwy 45] E Hidalgo-Queretaro state line [ca 6 mi W



Huichapán], 2103 m, Webb, 1982); these Hidalgo specimens (REO, UTEP) have small dorsal scales (35.0, 34-36, as in *olsoni*; Olson, 1998:79, Table 1, recorded 32-39), femoral pores averaging 11.2 (9-13), and the dorsal patterns of two adult females (REO 5862-63) are most like *S. m. mucronatus* (as illustrated in Pl. XLIX, Fig. 2 in Smith, "1936"[1938]). REO 5874, 83 mm SVL, has a distinct intertympanic band (also REO 5862), pale scales in black collar above shoulder, and a faded dorsal pattern (only indication of anteriormost black vertebral blotch).

Thus, *S. m. mucronatus* and *S. m. olsoni* are similar in the vertebral blotched dorsal pattern and some other pattern features (see Key). The two taxa seem to show intergradation, have similar femoral pore counts, but differ in average size of dorsal scales and aspects of dorsal pattern (see Comparisons and Key).

*Sceloporus m. aureolus*. Smith (1942:357) in his description of *S. m. aureolus* noted that he had "described this subspecies in detail as *mucronatus omiltemanus*." Except for the holotype and 26 topotypes (USNM 112232 and 112233-58) all other listed paratypes of *S. m. aureolus* (Smith, 1942:356) were previously assigned to *S. m. omiltemanus* (Smith, "1936"[1938]:596, including description, p. 591, Fig. 12 [side and dorsal head scalation] of EHT-HMS 3080, and the Veracruz specimen depicted in Pl. L, Fig. 1). His "Diagnosis" ("1936"[1938]:591 and Fig. 12) of *S. m. omiltemanus* was repeated (some changes) in Smith (1939:220-221, and Fig. 28).

Dorsal body patterns have black-edged scales and black longitudinal lines (adults). Smith ("1936"[1938]:594, as *S. m. omiltemanus*) noted a pattern of light lines (middle of each scale row) separated by narrow black lines. The pale intertympanic band is absent. The juvenile throat pattern (whitish medial streak) is lacking. Tails have indistinct pale and dark distal bands. Large adult males have uniformly blue throats with the chest and median abdominal region suffused with slate, and blackish near lateral blue belly patches; females usually have a whitish ventral surface often with a pale blue suffusion (Smith, "1936"[1938]:594, 596, as *S. m. omiltemanus*). Smith (1942) recorded dorsal scales averaging 34.3 (30-38,  $n = 59$ , 91.6% over 31), and femoral pores 14 (11-17,  $n = 124$ ). Alvarez and Huerta (1973, Jicotlán, Oaxaca [but mapped in Guerrero]) recorded dorsal scales as 34.1 (32-36), and femoral pores 13.0 (12-16).

Our additional material consists of seven specimens from Oaxaca (UTEP 7593-95, 5 km SW Tlaxaico, 2030 m [oak hillside/rock walls]; UTEP 7596, 3



km SW Cuquila, 7000 ft+ [oak-pine]; UTEP 7597-99, 7 km S [San Andrés Chicahuaxtla, 2094 m]; improved dirt road mileages (in 1968) between Tlaxiaco and Cuquila and Chicahuaxtla are respectively 17 and 20 kilometers. Webb and Baker (1969:148) commented on the Oaxaca specimens. Generally dorsal body patterns have black-edged scales (more evident in larger lizards) that may form longitudinal black lines (large male, 96 mm SVL, UTEP 7597); the only other male (UTEP 7596, 84 mm SVL) has black-edged scales but lacks longitudinal lines. Heads are dark grayish, patternless, with no pale intertympanic bands. Black collars are about 5 (4-6) scales wide, usually with no enclosed pale scales above the shoulder (pale scales indicated in two females, UTEP 7593, 7598). In life (2x2 transparencies) dorsal scales were orange-brown; the borders of the black collar were pale orange-yellow in a female (UTEP 7594, 75 mm SVL) but white in a male (UTEP 7596, 84 mm SVL, also greenish scales on forearms). Throat patterns may show some indistinct dark barring, but no pale, dark-bordered median streak; one female (UTEP 7595, 67 mm SVL) has the midventral pale streak evident anteriorly. The largest male (UTEP 7597, 96 mm SVL) with black-bordered, blue belly patches is mostly dark gray to black in the chest region and in the groins with dark pigment encroaching onto the preanal area (patchlike); the underside of the thighs and the midventral belly area are dark, almost black. The ventral pattern of the smaller male (UTEP 7596, 84 mm SVL, enlarged postanal scales and hemipenis partly everted) has a uniform pale blue throat but lacks abdominal belly patches (only pale blue wash as in females). The seven UTEP specimens from Oaxaca have dorsal scales averaging about 32.7 (32-34), scales around midbody 36.7 (36-38), and femoral pores 13.0 (12-14, one leg) or 26.0 (25-27, both legs). A female (UTEP 7594) has large (inner row) supraoculars suggesting one undivided row.

Gehlbach and Collette (1957, as *S. m. omiltemanus*, near Tlaxiaco, dorsal patterns not mentioned) noted maximal SVL of males as 101.5 and females 96.5 mm ( $n = 68$ ); they recorded dorsal scales averaging 33.5 (30-38) and femoral pores 13.6 (11-16). Lynch and Smith (1965, three from Chicahuaxtla) recorded 32, 33, 33 dorsal scales and 15-15, 15-14, 14-14 femoral pores.

Pending further data *Sceloporus mucronatus* in the Tlaxiaco-Chicahuaxtla area, is probably intergradient averaging smaller dorsal scales than in *S. m. omiltemanus*, and at least some specimens (Chicahuaxtla male, UTEP 7597, see above) having a longitudinally black-lined dorsal body pattern (as in *aureolus*).

*Sceloporus m. omiltemanus*. Smith (1942:357) noted *S. m. omiltemanus* as having fewer dorsal scales (averaging 30, 29-32, 92.3% less than 32) than *S. m. aureolus*, and that the latter differs from *S. m. omiltemanus* in having a lined dorsal body pattern in adult males; he recorded femoral pores averaging 13.8 (11-16,  $n = 26$ ), which do not differ appreciably from that of *S. m. aureolus* (four combined samples, see above, averaging 13-14, 11-17). The dorsal pattern of a Guerrero male is illustrated in Smith ("1936"[1938]:Pl. L, Fig. 2). Alvarez and Huerta (1973, Table 1, dorsal body patterns in adult males not mentioned) recorded dorsal scales (two samples, respectively, Guerrero and Sola de Vega, Oaxaca) averaging 30.5 (28-32,  $n = 7$ ) and 31.6 (28-34,  $n = 5$ ), and femoral pores 13.0 (12-16,  $n = 7$ ) and 13.0 (12-15,  $n = 5$ ). Another specimen from Guerrero (UTEP 14522, 3.5 mi SW Omilteme) has 31 dorsal scales, 32 midbody scales, and 13-15 femoral pores.

### Comparisons and Key

The foregoing data suggest two distinct groups of subspecies of *Sceloporus mucronatus*. One is comprised of the taxa *olsoni* and *mucronatus*, both of which have dorsal body patterns of black vertebral areas that may be separated (distinctly or indistinctly) into blotches by whitish markings and share some other pattern features (see Key); adult dorsal patterns of *S. m. olsoni* seem to be more pallid and distinct (Fig. 1) than in *S. m. mucronatus* (pattern more diffuse) and to differ in having a reddish color in life. Numbers of femoral pores (one leg) are similar in *S. m. olsoni* (13.5, 11-15) and *S. m. mucronatus* (combined average of three samples, plus five of Alvarez and Huerta, 12.4 [10.9-15.4], 9-17). The data indicate smaller dorsal scales in *olsoni* (34.3, 31-37) than in *mucronatus* (combined average of two samples, plus five of Alvarez and Huerta, 30.2 [29.3-31.7], 27-34). The two taxa (our collections) occupy different habitats with *olsoni* in semiarid, oak-scrub, and *mucronatus* in cold pine forest.

The other distinct populational segment of *S. mucronatus* comprises the taxa *aureolus* and *omiltemanus* that differ in the dorsal body patterns of adult males, either black-edged scales (no distinct lines, *S. m. omiltemanus*) or dark longitudinal lines (*S. m. aureolus*), plus some other pattern features (see Key). Femoral pores (one leg) overall are similar in *S. m. omiltemanus* (average of three samples, 13.3 [13.0-13.8], 11-16) and *aureolus* (four samples, 13.4 [13.0-14], 11-17). Dorsal scale counts of *omiltemanus* (average of three samples, 30.7 [30.0-31.6], 28-34) are lower than in *aureolus* (four samples, 33.6 [32.5-34.3], 30-38). Traditionally, the two subspecies have been distinguished by



relative size of dorsal scales, 31 or less in *omiltemanus* and 32 or more in *aureolus* (Smith and Taylor, 1950:123).

The two groups of subspecies of *Sceloporus mucronatus* (*olsoni-mucronatus* and *aureolus-omiltemanus*) are distinctive in dorsal body patterns; intermediate morphological variants between adjacent subspecies of each group, *mucronatus* and *aureolus*, are unknown; the two groups of subspecies possibly represent two species. Some of the other recorded pattern features distinguishing the two groups (in Key, couplet 1), however, are not totally mutually exclusive.

Key to Subspecies of *Sceloporus mucronatus*

- 1a. Dorsal body pattern with black scale edges and/or narrow, black, longitudinal lines; no pale intertympanic band; black collars often 5 (4-6) scales wide with no included pale scale above the shoulder; tails indistinctly banded; juvenile throat pattern lacking pale, dark-bordered, longitudinal median streak; females lacking well-developed blue belly patches; femoral pores averaging 13-14 (11-17, one leg) ..... 2
- 1b. Dorsal body pattern with either black mostly continuous vertebral area (blotches indistinct) or distinct black vertebral blotches; usually some evidence of pale intertympanic band; black collars narrow, no more than 4 scales wide, often with pale scale above shoulder; tails may be distinctly banded; juvenile throat pattern with longitudinal pale median streak; females with distinct blue belly patches; femoral pores averaging 12-13 (9-17, one leg) ..... 3
- 2a. Back of adult males with black longitudinal lines along scale edges; dorsal scales averaging about 33-34 (30-38). *S. m. aureolus*.
- 2b. Back of adult males having black scale edges but lacking distinct longitudinal lines; dorsal scales averaging 30-32 (28-34). *S. m. omiltemanus*.
- 3a. Dorsal scales averaging about 29-31 (27-34); adults with indistinct dorsal blotched pattern and not reddish in life. *S. m. mucronatus*.
- 3b. Dorsal scales averaging 34.3 (31-37); adults with distinct blotched pattern and reddish in life. *S. m. olsoni*.

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## Observations on the Diet of *Trachemys gaigeae* (Testudines: Emydidae)

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The Big Bend slider, *Trachemys gaigeae*, is a freshwater turtle of the Rio Grande drainage system of southern New Mexico, western Texas, eastern and central Chihuahua, and Coahuila (Ernst, 1992). Most research on *T. gaigeae* has focused on its systematic and taxonomic relationship to other sliders in the *T. scripta* complex (e.g., Ernst, 1992; Seidel et al., 1999), while relatively little attention has been directed to natural history (Ernst et al., 1994; Degenhardt et al., 1996). In this paper, we review previous publications on the food habits of *T. gaigeae* and provide new information obtained by several methods, including 1) trapping results using various trap baits, 2) fecal sample analysis, 3) dissection of freshly-killed specimens, 4) stomach-flushing, and 5) observations of specimens feeding in the wild and in captivity.

### Materials and methods

Our studies of *T. gaigeae* were primarily conducted during 1994-1998 at Bosque del Apache National Wildlife Refuge (BDA) and Elephant Butte Reservoir (EBR) in the Rio Grande Valley, Socorro and Sierra counties, New Mexico. Adult and subadult turtles were typically captured in nylon-mesh hoop-traps (130 cm long, 75 cm diameter) placed in lentic waters > 70 cm deep. Traps were baited with sardines, watermelon, or banana contained in a perforated can or wire-mesh bag to prevent consumption by captured turtles. Turtles less than 80 mm maximum straight-line carapace length (CL) were too small to be captured in the traps. Captives were retained for ca. 24 h for measurement and collection of fecal samples which were preserved in 10% formalin for later examination under a dissecting microscope. Most specimens were uniquely marked by shell notching and released at the capture site. Several egg clutches were obtained from wild-caught gravid females and incubated in the laboratory, and hatchlings were captive-reared for up to 12 months under laboratory conditions in aquaria and, during warmer months of the year, in outdoor metal tanks (ca. 1.5-2.2 m diam.). Concurrent with field studies, several adults were maintained for observation in outdoor metal tanks and a permanent outdoor pond (6.1 m diam.) on the University of New Mexico campus. Our identification and taxonomy of aquatic macrophytes in the study area follows Adams (1998).



### Previous reports

Several publications briefly discuss the food habits of *T. gaigeae*. Carr (1952) speculated that the species must be largely carnivorous based on the riverine habitat in Texas where it is found, whereas Legler (1960b) noted that the stomach contents of several *T. gaigeae* from the Rio Conchos, Chihuahua, consisted of only aquatic vegetation. Price and Hillis (1989) suggested that adult *T. gaigeae*, unlike *T. scripta* in Texas, are exclusively vegetarian. Ernst et al. (1994) noted that captives readily accepted fish. At BDA in New Mexico, Stuart (1995) noted the abundance of submerged aquatic macrophytes at capture sites, including pondweeds (*Potamogeton pectinatus* and *Zannichellia* sp.), and filamentous green algae (Chlorophyta), which were presumed food sources. Wilson et al. (1999) and Morjan and Stuart (2001) both reported filamentous green algae, fragments of aquatic vascular plants (primarily *Potamogeton* sp.), and parts of crayfish (*Orconectes* sp.) from the gastrointestinal tract and feces of two adult females (182 mm CL and 253.5 mm CL, respectively) from BDA.

In a study indirectly relevant to *T. gaigeae* food habits, Garcia (1973) examined the concentration of methyl mercury in body tissues of "*Pseudemys scripta*" (= *T. gaigeae*), *Apalone spinifera*, and numerous fish species in EBR, a major sediment trap on the Rio Grande. Mercury concentrations in liver and kidney tissues of both turtle species were significantly higher than those in fishes, whereas overall mercury concentrations were similar in turtles and predatory fish species, indicating possible bioamplification. Garcia (1973) suggested the carnivorous habits of both turtles, including scavenging of dead fishes, could account for high mercury concentrations in these species (methyl mercury can occur at higher concentrations in dead, decaying fish tissue than in fresh fish). The study found that mercury concentrations in mixed algae and bryophytes in the reservoir were also elevated.

### Attraction to baited traps

Legler (1960a; 1960b) noted that *T. gaigeae*, which he considered to be chiefly herbivorous, was attracted to meat or fish baits. In our study, perforated cans of sardines in oil or tomato sauce proved to be an effective attractant for *T. gaigeae* for trapping periods of up to 4 days. Sliced watermelon and banana wrapped in small-mesh screen material was used to a lesser extent as bait; this method also attracted *T. gaigeae*, albeit for only the first 24 hrs of trapping.

Freshwater fishes (e.g., *Cyprinus carpio*, *Ictalurus* sp., *Micropterus* sp.) taken as bycatch in traps with *T. gaigeae* were occasionally sacrificed and left in traps as an additional attractant for turtles. These fish carcasses were often found partially consumed during subsequent trap checks, presumably by the turtles occupying the traps.

### Fecal sample analysis

Newly-captured adults and subadults taken at BDA during June-August typically defecated large quantities of loosely-consolidated vegetable material. Casual examination of this material indicated the presence of aquatic vascular plants and filamentous algae. One male (167 mm CL) had ingested parts of a grasshopper (Orthoptera) along with filamentous algae.

A more detailed examination of preserved fecal samples from 14 adults (160-224 mm CL) captured at BDA in 1994 indicated the following items as the major foods: fragments of unidentified vascular plants (6 samples); the filamentous alga *Oedogonium* (4 samples), a filamentous alga similar to *Rhizoclonium* (2 samples); and two unidentified filamentous algae (1 sample). An unidentified pollen was the sole item in 1 sample. Secondary food items in these 14 samples included the following: diatoms (i.e., *Gomphonema*, *Cocconeis*, and *Epithemia*; presumably epiphytic on the filamentous algae), the protozoan *Vorticella*, a desmid alga (*Pediastrum* sp.), unidentified coccoid green algae, and an unidentified fungus. One adult collected from the Rio Grande near Las Palomas, Sierra County appeared to have pieces of muskgrass (*Chara vulgaris*) in its feces; this alga was observed growing near the capture site. A fecal sample from a female (173.5 mm CL) trapped near Las Palomas on 13 August 1993 consisted of unidentified vascular plant material and diatoms.

Terrestrial vegetation was also detected in some fecal samples. Three adult *T. gaigeae* (140-221 mm CL) collected from the Rio Grande in Brewster County, Texas in April 1997 and reported by Seidel et al. (1997) were temporarily held in captivity before being sacrificed. Feces from these turtles consisted almost exclusively of fragments of giant reed (*Arundo donax*). This grass was growing along the shoreline in the vicinity of trap sites (W.G. Degenhardt, pers. comm.). During 19-20 May 1998 in a cove at EBR, we trapped several large adults that defecated fragments of an unidentified grass. Water depth at trap sites was < 1 m, and recently-sprouted grasses and forbs along the shoreline had been inundated by the rising reservoir level.



### Dissection of preserved specimens

Few specimens of *T. gaigeae* were sacrificed and dissected during our study. Wilson et al. (1999) reported food items from one such specimen, which primarily contained large quantities of filamentous algae and pieces of vascular plants in its stomach and intestinal tract. Similarly, an adult female (235.5 mm CL) that drowned in a trap at BDA on 2 June 1998 had a large quantity of filamentous algae and fragments of vascular plants (probably *P. pectinatus*) in its stomach; the intestinal tract was empty. A melanistic adult male (210 mm CL) collected at BDA on 2 August 1993 had only filamentous algae in its intestinal tract

### Stomach-flushing

Parmenter and Avery (1990) described a method for stomach-flushing live turtles to obtain food items. We successfully tested a similar device on an adult female *T. gaigeae* (238 mm CL) captured at BDA on 31 August 1994. The stomach was filled with two forms of filamentous green algae: *Mougeotia* sp. and *Rhizoclonium* sp. (or a similar taxon).

### Observations in the wild

Opportunities to observe natural feeding by *T. gaigeae* in New Mexico were very limited due to the high turbidity of water bodies where the species was found. On 31 July 1997, we observed a small adult at EBR as it floated near the water surface and cropped filamentous algae growing on the partially submerged branch of a dead tree.

Indirect information on diet was provided by observations of aquatic plants in proximity to trap sites. At BDA, *T. gaigeae* was most frequently trapped in ponds that supported dense growths of *Potamogeton pectinatus* and floating mats of filamentous green algae, usually from early June to early September. At EBR, we trapped *T. gaigeae* near dense growths of milfoil (*Myriophyllum verticillatum* or *M. spicatum*) in the littoral zone of deep-water coves; *Potamogeton crispus* was also present in lesser quantities in the reservoir.

### Observations of captive specimens

Adult and subadult turtles maintained in captivity were offered a variety of food items including locally collected aquatic plants (*Myriophyllum* sp., *Potamogeton pectinatus*, and *P. crispus*); red-leaf and Romaine lettuce; chopped uncooked pieces of fish, squid, and chicken; and commercially-available pel-

let food for fish and reptiles. Observation and examination of feces indicated that all these items were consumed by captives. On several occasions adults were observed to feed almost exclusively on fish and meat even when vegetable material was also available. Three adult specimens from Brewster County, Texas that were briefly held in captivity showed a preference for lettuce and mostly ignored *Myriophyllum* that was also available. Feeding occurred at almost any time of day, including evening. Adults maintained in the outdoor pond were observed cropping filamentous algae from the wall of the pond. On one occasion, an adult was observed feeding on a cockroach (*Blatta* sp.) that fell into its tank.

Hatchling and small juvenile *T. gaigeae* (30-40 mm CL) readily fed on commercially-available frozen brine shrimp (*Artemia* sp.) and *Tubifex* worms, and finely-chopped pieces of raw fish and canned squid. Hatchlings maintained in aquaria showed little interest in commercial turtle pellets, filamentous algae or other plant materials. Feces from hatchlings maintained in outdoor tanks were composed primarily of unidentified insect parts, although small amounts of vegetable matter were also present. Outdoor tanks occupied by hatchlings were noticeably free of mosquito (*Culicidae*) larvae as compared to adjacent tanks that lacked hatchlings. A hatchling placed in a small water bowl with 15 mosquito larvae consumed all the larvae within 2 h. Another hatchling temporarily placed in a shallow outdoor tank for photographic purposes was observed gleaning aquatic larvae of an unidentified insect while sitting motionless on the substrate (D. Sias, *pers. comm.*).

### Comments

Our data indicate that *T. gaigeae* is omnivorous, but that adults and subadults (i.e., individuals > ca.140 mm CL) are primarily herbivorous. Small invertebrates may be ingested by adults incidentally with vegetation, whereas larger organisms (e.g., crayfish) are possibly consumed directly. Dead fish and crayfish may also be scavenged opportunistically. Hatchlings and small juveniles (30-40 mm CL) appear to feed primarily on small invertebrates. We captured few individuals of intermediate size (40-140 mm CL) and can only infer that a gradual dietary shift from primarily invertebrates to vegetation occurs during this stage of growth.

Previous dietary studies of *Trachemys* spp., especially *T. scripta* (*sensu stricto*) in the United States, indicate that sliders are opportunistic omnivores that consume a wide variety of invertebrates, vertebrates, and vegetation (see



review by Parmenter and Avery, 1990). Adult *T. scripta* (*sensu stricto*) generally consume a much greater percentage of vegetation than do hatchlings and juveniles, reflecting ontogenetic shifts in energy and nutrient requirements, foraging habits, and microhabitat use (Parmenter and Avery, 1990). Our evidence suggests that *T. gaigeae* follows the pattern observed in other species and populations of *Trachemys*.

Neustophagia, a type of ingestion in which small food particles floating on the water's surface (neuston) are skimmed and "filtered" in the turtle's mouth, has been reported in *T. scripta* and other emydids (Parmenter and Avery, 1990). Although we have no direct evidence that neustophagia is used by *T. gaigeae*, the presence of only pollen in one fecal sample examined suggests that it may occasionally be employed by this species.

Although we did not observe fish consumption under natural conditions, our observations of captive turtles suggest the species readily scavenges dead fish when available. The deepwater habitats adjacent to the littoral areas frequented by *T. gaigeae* at EBR support a diversity of large fish species (Sublette et al., 1990). During trapping efforts at EBR in May 1998, we observed extensive post-spawning mortality of shad (*Dorosoma* sp.). We suspect seasonal fish mortality may provide an important food source for *T. gaigeae* at EBR, especially early in the annual activity season when aquatic vegetation is sparse.

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## Evolutionary Speciation in the Alligator Lizards of the Genus *Barisia*

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### Abstract.

*Barisia imbricata auctorum* is a superspecies consisting of four sibling species: *B. ciliaris*, *B. imbricata*, *B. jonesi* and *B. planifrons*.

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Guillette and Smith (1982) recorded detailed information on external variation in *Barisia imbricata* (Wiegmann), recognizing four subspecies: *B. i. imbricata*, *B. i. ciliaris* (Smith), *B. i. jonesi* Guillette and Smith, and *B. i. planifrons* (Bocourt).

Good (1988) accepted that arrangement, as have most other authors. His review of the Gerrhonotinae also included *B. levicollis* (Stejneger) and *B. rudicollis* (Wiegmann) in the genus *Barisia*, as generally accepted since Tihen (1949).

Good (1988) also stated (p. 81) that "*Barisia levicollis* is probably no more different from *B. imbricata* than the various subspecies of *B. imbricata* are from each other; either its specific status or the subspecific status of some of the *B. imbricata* subspecies is therefore open to question."

On the contrary, five categorical differences distinguish *B. levicollis* from the subspecies of *B. imbricata*: a single superciliary (vs 2-4, except for one anomalous specimen in 192 with 0); 46-51 dorsals (vs 39-45); postoculars 1-2 (vs 3-4); no preocular contact with anterior superciliary (vs 100%); and preocular in contact with both anterior medial and lateral supraoculars (vs 0%). The last two, however, are contingent upon the first, but that still leaves three independent categorical differences of *B. levicollis* from *B. imbricata*. In addition, the two species are broadly dichopatric (Fig. 1).

Thus we regard *B. levicollis* as unassailably a separate species from *B. imbricata*.

Each of the subspecies of *B. imbricata* also has at least one categorical distinction from the others. Most notable is the unique occurrence, in the *B. imbricata* complex, of 12-14 dorsal scale rows in *B. i. imbricata*; all other sub-

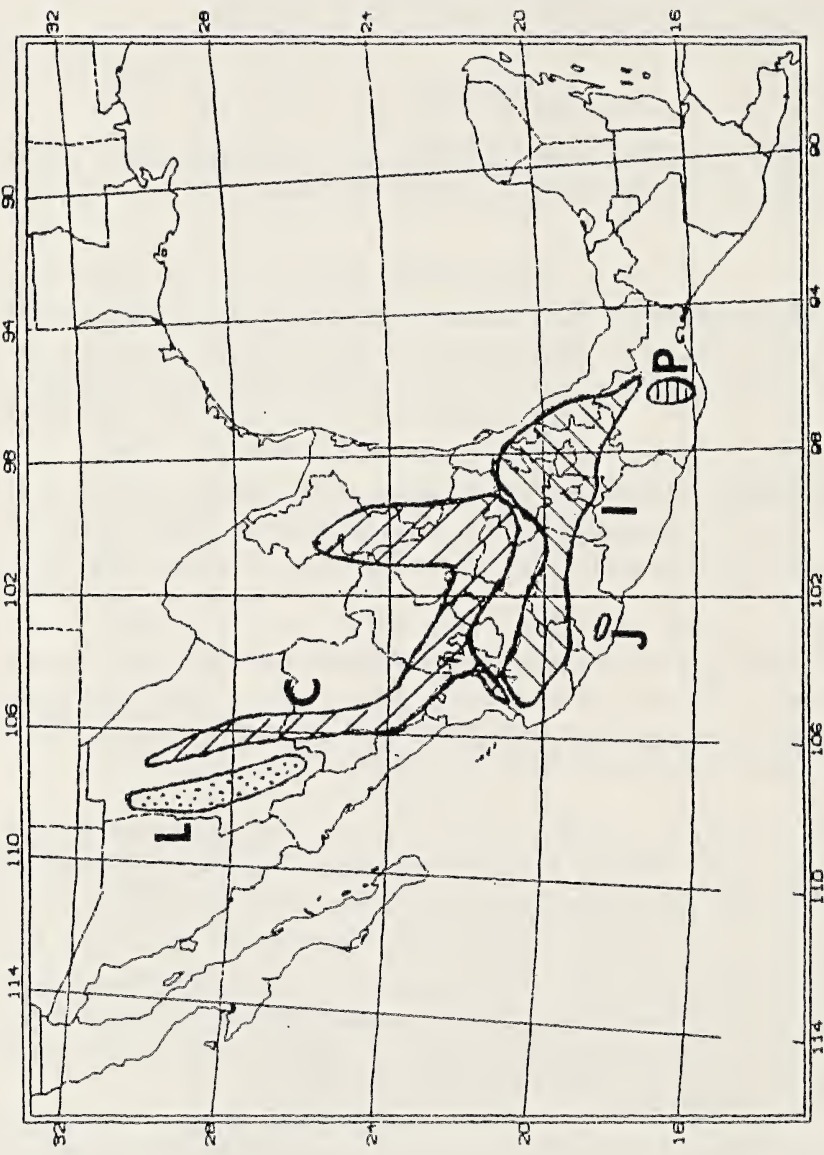


Fig. 1. Distribution of the five members of the *Barisia imbricata* complex. C, *B. ciliaris*; I, *B. imbricata*; J, *B. jonesi*; L, *B. levicollis*; P, *B. planifrons*.



species, as well as *B. levicollis*, have 16. It is also dichopatric from *B. i. jonesi* and *B. i. planifrons*, partially parapatric with and partially dichopatric from *B. i. ciliaris*. Nevertheless, there is no indication of intergradation between the latter and *B. i. imbricata*, despite the parapatry that seems to exist. Although Fig. 1 indicates partial dichopatry, on the basis of available specimens, parapatry may well occur there as well as elsewhere. *B. i. imbricata* occupies a central position; all of the others are peripheral (Fig. 1).

The most readily distinguishable of the three peripheral subspecies is *B. i. ciliaris*, which is light tan at least in adults. In the other two, the ground color is invariably dark, often with still darker markings dorsally.

A noncategorical but partially diagnostic difference of *B. i. ciliaris* from *B. i. jonesi* and *B. i. planifrons* is the presence of two loreals in 79% (N=45) of the former, one in 100% of the two others. *B. i. ciliaris* reaches a greater size (158 mm SVL) than the other two (133 mm in *B. i. jonesi*, 122 mm in *B. i. planifrons*). Obviously there is no intergradation of any, because they are widely dichopatric.

The light dorsal color of *B. i. ciliaris* is shared in *Barisia* only with *B. levicollis*. Indeed, examples of the former were long thought to be the latter because of the similarity in coloration, and the name *ciliaris* was applied in reference to the fact that, contrary to *B. levicollis*, it has a full set of superciliaries.

The two dichopatric populations of *B. imbricata* (*B. i. jonesi*, *B. i. planifrons*) have a highly restricted range, far from each other. They categorically differ from each other in at least two ways: *B. i. jonesi* has sharply keeled dorsals and the lower anterior temporal is in contact with two supralabials, as opposed to obtuse keels and a single supralabial in contact with the lower anterior temporal in *B. i. planifrons*. There is only a slight overlap in dorsal scale count, 34-39 in the latter, 39-42 in the former.

In view of the existence of categorical difference separating all four subspecies of *B. imbricata*, the absence of evidence of intergradation where parapatry appears to occur (and the dichopatry of other populations), we suggest that all four taxa are evolutionarily qualified as species. They are not as distinct from each other as *B. levicollis* is from the *B. imbricata* complex, but species are highly variable in degree of difference. The four in the *B. imbricata* complex may be regarded as sibling species (e.g. Mayr and Ashlock, 1991), which are less readily distinguished from each other than the members of the *B. imbricata* complex are from the rest of the species of *Barisia*. We therefore



propose that the taxa conventionally regarded as subspecies of *B. imbricata* be known as *B. ciliaris*, *B. imbricata*, *B. jonesi* and *B. planifrons*.

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## A New Species of *Conophis* (Reptilia: Serpentes) From Los Tuxtlas, an Area of High Endemism in Southern Veracruz, Mexico

Gonzalo Pérez-Higareda, Marco A. López-Luna and Hobart M. Smith

### Abstract

*Conophis morai* is described from a unique habitat for the genus in the elevated rain forest of Los Tuxtlas, southern Veracruz, south of the range of *C. lineatus*, here regarded as a species distinct from *C. concolor*.

The only *Conophis* known to occur on Atlantic slopes of Mexico outside of the Yucatán Peninsula, where *C. l. concolor* occurs, is *C. l. lineatus* (Duméril, Bibron and Duméril), occurring on the coastal plains and lowlands of central Veracruz as far south as Lerdo de Tejada (Wellman, 1963; Pérez-Higareda and Smith, 1991), in grasslands and deciduous forest areas.

However, one *Conophis* was taken by Roberto Mora 12 April 1999 in a very different, elevated habitat in rain forest on the southeastern slope of San Martín Tuxtla Volcano, some 60 km southeast of Lerdo de Tejada. We are not aware of any other voucher specimen taken in Veracruz in a similar habitat, or that far from the known range of *C. lineatus*.

The specimen exhibits numerous differences from typical specimens of *C. lineatus* in coloration and pattern. In view of these differences, correlated with distance from other *Conophis* records, from a unique environment given to a high degree of endemism, we regard it as representative of a distinct species here named

### *Conophis morai* sp. nov.

*Holotype*. UNAM-LT 3662, an adult male, from Ejido Ruiz Cortines on the southeastern slope of San Martín Tuxtla Volcano, 1050 m, taken by Roberto Mora 12 April 1999.

*Diagnosis*. Different from *C. lineatus*, the only other striped member of the genus on the east coast of Mexico, in having the dorsolateral and lateral dark stripes continuous and split by a white line throughout the length of body, including neck, occupying two scale rows; sublateral stripe continuous, uninterrupted except on neck; spot at ends of ventrals sharply defined,

not diffuse; both dorsal and ventral edges of supralabials black; ventral surface of head mostly black, from mental to the first few ventrals; posterior edge of each ventral on anterior part of body black; rest of venter gray, with several irregular black spots on midbody ventrals.

*Description of holotype.* Scalation much as in other members of *Conophis*, none of which are distinguishable by morphological characters alone. Head scales normal: 7-8 supralabials, 3rd and 4th entering orbit on the side with 7, 4th and 5th on the other; 9-9 infralabials; 1-1 preoculars; 1-1 loreals; 2-2 postoculars; 2-2 temporals; 19-19-17 scale rows; no keels; 165 ventrals; subcaudals 66; 664 mm total length. Condition excellent except left side of head damaged.

Dorsal ground color greenish gray in life, gray in preservative. Dorso-lateral stripes broad throughout, beginning on edges of prefrontal and frontal, on the neck each forming a pair of continuous black lines separated by a narrow white line throughout the length of the body, on the 7th and 8th scale rows anteriorly, 6th and 7th posteriorly (Fig. 1). Lateral line broad throughout, beginning on rostral, passing through eye, covering the upper edges of the supralabials (Fig. 3), and splitting into two continuous black lines separated by a white line five scales behind the head, extending throughout the length of body on 3rd and 4th rows anteriorly, 2nd and 3rd posteriorly.

A sublateral dark line begins on neck as a series of spots on the 1st scale row, but posterior to the 10th ventral forming a single, continuous black line, similar to the others, on 1st dorsal scale row throughout the length of the body, but absent on tail.

A sharply defined black spot on each end of each ventral; ventral surface of head dark from mental to first few ventrals (Fig. 3). On each side of each ventral a distinct, sharply defined, oval dark spot, not diffuse or angular in shape (Fig. 1). The posterior edge on each of the first 20 ventrals is black (Fig. 4). The rest of the venter is white, except at midbody (Fig. 4), with several irregular black spots on the ventrals, varying in size from almost an entire ventral to small ones no larger than the regular spot on each end of each ventral.

Supralabials with black dorsal and ventral edges bordering a continuous white line along the middle of the scales. Ventral surface of head largely black, from mental to first few ventrals (Fig. 3).





Fig. 1. Midbody pattern of the holotype of *C. morai*.

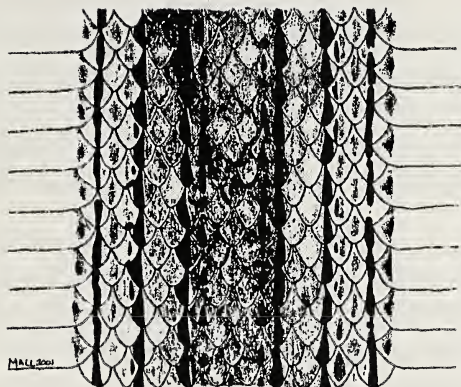


Fig. 2. Midbody pattern of *C. lineatus*, Cotaxtla, Veracruz, from UNAM-LT 3812.



Fig. 3. Head pattern of the holotype of *C. morai*. Above, ventral view; below, lateral view.



Fig. 4. Ventral pattern on body. Left, neck region at ventrals 15-23; right, midabdomen at ventrals 49-57. Other irregular dark blotches appear between ventrals 58-65, one on ventral 86, and others on ventrals 93-96, the latter small and diffuse. The rest of the ventrals are unmarked except for the dark spot on each end of each ventral; they continue onto the basal 15 subcaudals, but otherwise the venter and subcaudal surfaces are white.

*Comparisons.* *C. maria* differs from the nearest taxon of the genus, *C. lineatus*, as follows. Character-states for *C. l. lineatus* are largely based on Wellman (1963); GPH also examined a few specimens in Mexican collections.

(1). Ground color greenish gray, gray in preservative (vs "white, tan-nish white, or often pale blue" in preservative [Wellman, 1963]).

(2). Sharply defined, continuous dorsolateral and lateral stripes, broad on head, on body split into two on adjacent scale rows, enclosing a white line between, extending the full length of the body (vs generally on a single scale row, anteriorly often a series of spots, in some expanded only posteriorly onto the adjacent scale row, but accessory lines discontinuous where present and light area between gray, not white).

(3). Sublateral stripe sharply defined and continuous throughout length of body, on neck appearing as a series of spots, one on each scale of first dorsal scale row; scale row between sublateral and lateral stripes white (vs a series of dark-centered scales, in some forming short continuous sections, often scarcely visible; area between sublateral and lateral stripes gray, not white).

(4). Supralabials black dorsally and ventrally, with a white line between (vs black ventrally only).

(5). Ventral surface of head largely black (vs unmarked or with a few small, scattered black flecks).

(6). Black spot on each end of each ventral sharply defined, oval (vs diffuse, angular).

(7). Venter white, anterior ventrals black-edged, midbody ones with irregular black blotches (vs white, no markings except for spots on ends of ventrals).

The only other *Conophis* known from Atlantic slopes of Mexico is what Wellman (1963) designated *C. lineatus concolor*. As represented in Mexico, it is readily distinguished by its unicolor dorsum, lacking stripes. It is known no closer to the Los Tuxtlas area than Campeche.

*Etymology.* The patronym honors Biologist Roberto Mora, collector and donor of the holotype.



*Comments.* In view of (1) the many unique features of the holotype of *C. morai*, compared with the adjacent *C. lineatus* (see preceding), and even all of the other taxa of the genus (most notably the head and ventral markings), and (2) occurrence in a sharply different habitat from that characteristic of the genus, in a dichopatric area of considerable endemism, *C. morai* is reasonably assured as a distinct species. Further voucher examples will be required for verification.

No specimens of *Conophis* are known between the ranges of *C. lineatus* and *C. morai* to the north and the nearest other population of the genus, in Campeche, northern Yucatán and Belize. A hiatus of some 500 km separates them. A sharp difference exists between the northern populations and the cited southern populations; without exception the former is lined, whereas the southern one is lineless. Farther southeast the unicolor populations blend with lined ones, and there is no geographic hiatus between them. We therefore propose that *C. lineatus* is a monotypic species, limited to central Veracruz. The southern group consists of geographic and/or populational variants of apparently one species, *C. concolor*, including the nominal taxa *C. l. dunni* and *C. pulcher*, *fide* Wilson and Meyer (1985), Lee (1996), and Campbell (1998).

One other specimen, an adult male presumably of *C. morai*, was caught by GPH September 1981, retained briefly, and later escaped before detailed observations were made. Field notes indicate that its ground color was gray-olive. It was found in rain forest at 200 m, San Pabla Siqueda, Balzapote, municipality of Ssn Andrés Tuxtla, Veracruz.

### Acknowledgment.

All drawings are by Marcos A. López-Luna.



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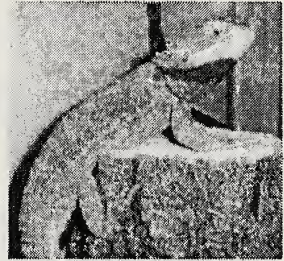
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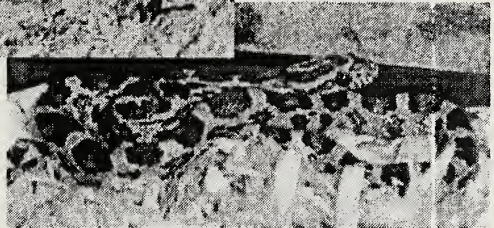
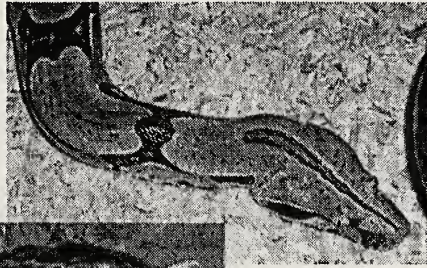
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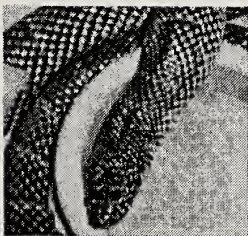
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## Errata

Paulino Ponce Campos apologizes due to a mistake in the name of the third author in the paper on pages 18-21 in Volume 37, Number 1. Following is the correct citation:

Paulino Ponce Campos, Sara M. Huerta Ortega, Carlos Nogueira Bómex and Hobart M. Smith.

2001. National history notes on the southern plateau night lizard, *Xantusia sanchezi*. Bulletin of the Maryland Herpetological Society. Volume 37 Number 1. 18-21.









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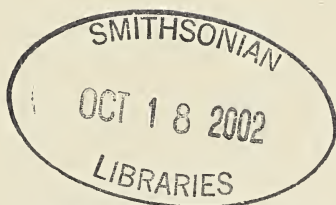
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## Parasites in Snakes of Thailand

*Naiyana Chaiyabutr and Lawan Chanhom*

### Abstract

A survey of parasites was conducted in 128 snakes belonging to 17 species of the families Pythonidae, Colubridae, Elapidae and Viperidae. Seventy-five percent of the snakes examined were found to be infected with endoparasites and ectoparasites. Endoparasites included five species of nematodes, one species of cestode, one species of trematode, one species of Acanthocephala, one tongue worm and one species of protozoa. The ectoparasites found were the hard ticks of the genera *Ixodes* sp., *Haemaphysalis* sp. and *Aponomma* sp. The results indicate that the most abundant parasite in the sample studied is *Kalicephalus laticaudae* which adversely affects the captive breeding programme of the snake farm at Queen Saovabha Memorial Institute (QSMI) and it is the main cause of mortality in the snakes kept in captivity.

### Introduction

The snake farm of the Queen Saovabha Memorial Institute (QSMI) maintains various species of non-venomous and venomous snakes for both public display and venom extraction. Venom extracted is used for both immunizing horses for antivenom production and venom research. Prior to 1994, most of the snakes at the institute had been purchased from dealers. The captive breeding program was initiated in order to supply healthy snakes for antivenom production and decrease the number of the wild snakes captured. Original breeding stocks due to heavy parasite infestations, including wild-caught snakes, had a short life span. Heavy parasitic infection in snakes has been shown to adversely affect reproductive ability (Klingenberg, 1993). Thailand has a diverse snake fauna comprising of 163 species (Jintakune and Chanhom, 1995), but little is known of their endoparasites and ectoparasites. A number of studies have been reported concerning parasites in snakes of Malaysia (Ambu et al., 1990; Tat et al., 1980), Philippines (Fishtal and Kuntz, 1964) and Japan (Kagei, 1972; Kagei and Kifune, 1977). The present study was carried out to survey parasites in different species of Thai snakes at the snake farm of the QSMI which were purchased from dealers.

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Key words: Snake farm, Thai snakes, endoparasites, ectoparasites.

### Materials and Methods

The parasitic survey was carried out from March 1996 to October 1998. The 128 snakes belonging to 17 species from the families Pythonidae, Colubridae, Elapidae, and Viperidae were examined. The procedures are as follow:

#### 1) Direct fecal smear

Snakes were collected as fresh as possible and stored in the refrigerator in clean, dry containers with air tight lids. Samples were fixed in 10% formaldehyde solution. Small amount of each sample was applied to a slide, covered with a cover glass and then examined with the light microscope.

#### 2) Post-mortem examination

Dead snakes were kept in the refrigerator prior to post-mortem examination. The parasites obtained from G.I. tract, muscle, soft tissue and skin were stored in 70% alcohol for identification. For detailed studies, nematodes were transferred to lacto-phenol medium; trematodes, cestodes and acanthocephalas were stained with acid carmine, dehydrated in alcohol, cleared in methyl salicylate and mounted in permount.

3) Physical examination and skin incisions were performed on living snakes for ectoparasites and subcutaneous parasites, respectively. Ectoparasites were cleared and studied in Hoyer's medium.

### Results

Of the 128 snakes examined, 96 snakes (75%) were found to be infested with different types of parasites (Table 1 & 2). Five species of nematodes, one specie of cestode, one specie of trematode, one specie of acanthocephala, one tongue worm and one specie of protozoan were found.

#### **Venomous snakes**

Of the 128 snakes examined, a total of 111 (11 species) were venomous snakes. Examination of these snakes for parasites showed that 84 (75%) were infested with parasites (Table 1).

Five species of nematodes were identified as follows: Hook worms, *Kalicephalus laticaudae* (fig. 2 & 3) were found in 7 species of snakes (Table 2).





Figure 1. Hookworm (*Kalicephalus laticaudae*) ova, 200x.



Figure 2. The anterior end of *Kalicephalus laticaudae*, 200x.

Table 1. Number of different species of snakes examined for parasitic infection.

<u>Snake species</u>	<u>No. of snakes examined</u>	<u>Total number of infected (%)</u>
<b><i>Venomous</i></b>		
1. <i>Naja kaouthia</i>	38	23(60.5)
2. <i>Naja siamensis</i>	16	16(100)
3. <i>Ophio phagus hannah</i>	9	9(100)
4. <i>Bungarus fasciatus</i>	8	8(100)
5. <i>Bungarus candidus</i>	9	9(100)
6. <i>Bungarus flaviceps</i>	4	3(75)
7. <i>Daboia russelii siamensis</i>	7	4(57)
8. <i>Calloselasma rhodostoma</i>	5	5(100)
9. <i>Trimeresurus albolabris</i>	9	3(33)
10. <i>Trimeresurus popeiorum</i>	2	0(0)
11. <i>Trimeresurus kanburiensis</i>	4	4(100)
<b><i>Non-Venomous</i></b>		
1. <i>Python curtus</i>	1	1(100)
2. <i>Elaphe radiata</i>	4	1(25)
3. <i>Elaphe taeniura ridleyi</i>	2	0(0)
4. <i>Lycodon laoensis</i>	2	2(100)
5. <i>Rhabdophis subminiatus</i>	6	6(100)
6. <i>Enhydris enhydris</i>	2	0(100)
<b>Total 17 species</b>	<b>128</b>	<b>96(75)</b>

Table 2. Species of parasite infecting snakes of Thailand.

	Species and number of snakes infected																	
	Venomous												Non-Venomous					
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	
<b>Endoparasites</b>																		
<b>Nematode</b>																		
<i>Kalicephalus</i>																		
<i>laticaudae</i>	23	16	0	8	9	0	4	5	3	0	0	1	0	0	2	4	0	
<i>Capillaria</i> sp. (ova)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
<i>Oxyurus</i> sp. (ova)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Tangua tiara</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
<i>Strongyloides</i> sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Cestodea</b>																		
<i>Spirometra reptans</i> (larva)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
<b>Trematodes</b>																		
<i>Paradiastomum</i> sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
<b>Intestinal protozoa</b>																		
<i>Isospora</i> sp. (sporocyst)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<b>Acanthocephala</b>																		
<i>Acanthocephalus</i> <i>ranae</i>	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
<b>Tongue worm</b>																		
<i>Leiperia gracilis</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
<b>Ectoparasite</b>																		
<i>Ixodes</i> sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
<i>Haemaphysalis</i> sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
<i>Aponomma</i> sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

**Venomous snakes**

1. *Naja kaouthia* 2. *Naja siamensis* 3. *Ophiophagus hannah* 4. *Bungarus fasciatus* 5. *Bungarus cadidus*  
 6. *Bungarus flaviceps* 7. *Daboia russelii siamensis* 8. *Calloselasma rhodostoma*  
 9. *Trimeresurus albolabris* 10. *Trimeresurus popeiorum* 11. *Trimeresurus kanburiensis*

**Non-Venomous snakes**

1. *Python curtus* 2. *Elaphe radiata* 3. *Elaphe taeniura ridleyi* 4. *Lycodon laoensis*  
 5. *Rhabdophis subminiatus* 6. *Enhydryis enhydryis*



The character of this parasite consists of a buccal capsule which is strongly developed, globular or subglobular or funnel-shaped, usually with dorsal groove. The esophageal funnel may contain three small teeth. Males show a bursa at the posterior end and a trilobed, dorsal lobe projecting beyond lateral lobes. Two spicules are equal. Females: posterior extremity is long, conical; vulva in posterior part of body; uterine branches opposed or parallel (Ambu et al., 1990). Thin wall oval eggs of this nematode were found in fecal smears (fig. 1) and accounted for 30.5% of the infection rate in the snakes examined. A total of 50 worms (20 males and 30 females) were found. Eggs of *Oxyurus* sp. were examined from the feces of *Ophiophagus hannah* (fig 6) and were larger than the eggs of the hook worm. Larvae and eggs were found in *Naja kaouthia* feces were identified as *Strongyloides* sp. (fig. 7 & 8). Operculated oval-shaped eggs of *Capillaria* sp. were also identified from the feces of these snakes (fig. 9).

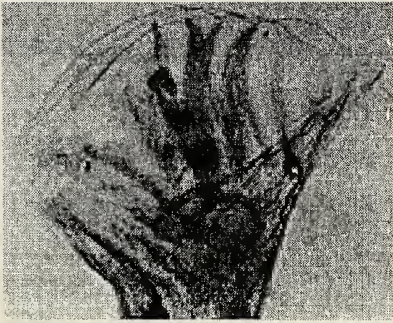


Figure 3. The posterior end of male *Kalicephalus laticaudae*, 200x.



Figure 4. The anterior end of male *Tangua tiara*, 100x.



Figure 5. The posterior end of male *Tangua tiara*, 100x.

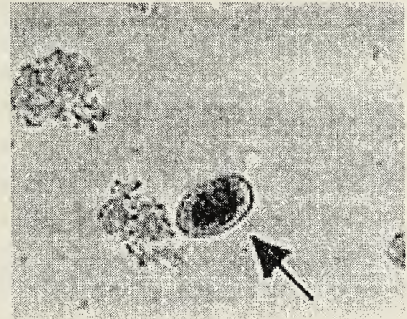


Figure 6. Pinworm ova, (*Oxyurus* sp.) 100x.



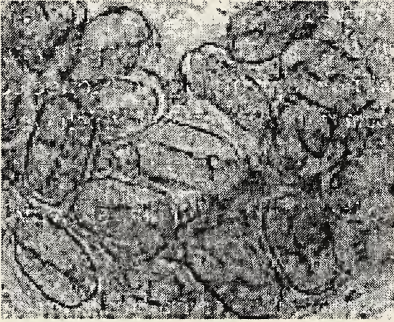


Figure 7. *Strongyloides* ova, 400x.



Figure 8. Larvae of *Strongyloides* 100x.

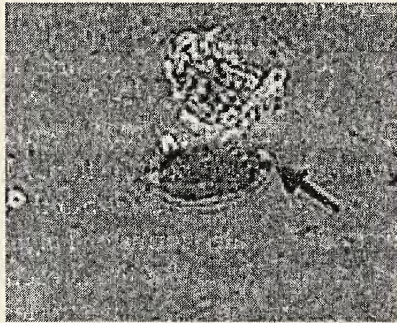


Figure 9. *Capillaria* ova with both-ends operculum, 200x.

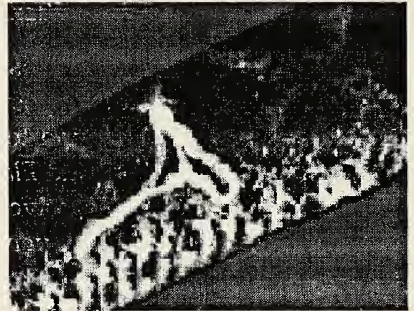


Figure 10. Sparganum of *Spirometra reptans* was removed by skin incision, in *Calloselasma rhodostoma*.

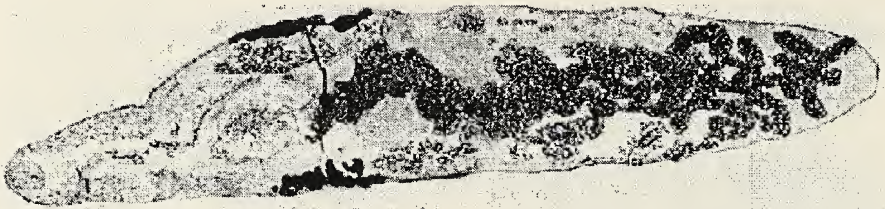


Figure 11. The ventral view of *Paradiastomum* sp., 100x.

Cestodes were found in both venomous and non-venomous snakes. It was juvenile stages called "sparganum" which were collected from dense nodules in muscles, subcutaneous tissues, coelomic cavities, the mesentery of GI tract, and gall bladders. Sparganum was found mostly under the skin of the snakes from South Thailand and were removed by skin incision (fig. 10).

A trematode (adult liver fluke) found in the fecal sample of *Calloselasma rhodostoma* was identified as *Paradiastomum* sp (fig. 11). One specie of protozoa was recovered in the fecal smear and intestinal contents of the Monocled Cobra (*Naja kaouthia*) and Russell's Viper (*Daboia russelii siamensis*) which were collected in central Thailand.

Oocysts of an intestinal protozoan were identified as *Isospora* sp. which had two sporocysts (fig. 14).

The ectoparasites found were the hard ticks of the genera *Ixodes* sp (fig. 15), *Haemaphysalis* sp (fig. 16) and *Aponomma* sp (fig 17) and were found under the body scales, on the head, and around the eyes.

### Non-venomous snakes

A total 17 non-venomous snakes (6 species) were examined and 12 snakes (70.6%) were found positive for endoparasites (Table 1 & 2). Four species of snakes were found to have a high rate of infection (100%) while only one specie had 25% and *Elaphe taeniara ridleyi* showed no infection. All venomous snakes were negative for *Tangva tiara* and *Leiperia gracilis* but they are found commonly in non-venomous snakes. Only male worms of *Tangva tiara* (family Gnathostomatidae) were found in the GI tract in the present study (fig. 4 & 5). This parasite had a head bulb which was coarsely striated transversely, unarmed, divided externally into two or four swellings containing balloonets. The cuticle behind the head bulb was forming a more or less pronounced collar. The posterior end had caudal alae which was well developed, eight pairs of caudal papillae. Two spicules were equal, tubular, with smooth tips (Yamaguti, 1935). In *Rhabdophis subminiatus* we found the *Acanthocephalus ranae* in the soft tissue of the abdominal cavity. Several morphologies serve to separate acanthocephalans from other parasitic worms. The most distinguishable character was the presence of numerous hooks on the protusible proboscis. The samples collected from post-mortem examination had five rows of hooks on the proboscis (fig. 12). *Leiperia gracilis* (fig. 13) was found in the vomitus of Blood Python (*Python curtus*). Its size was 4-5 cm. with four pairs of hooks on the head. This worm is related to the Arachnida and generally lives in bronchi, lungs, and rarely in the heart or head.

### Discussion

The high mortality rate of the venomous snakes maintained at the snake farm of Queen Saovabha Memorial Institute is a major problem. Postmortem





Figure 12. The five rows of hooks on the proboscis of *Acanthocephala ranae*, 100x.



Figure 13. The four pairs of hooks on proboscis (arrow) of *Leiperia gracilis*, 100x.

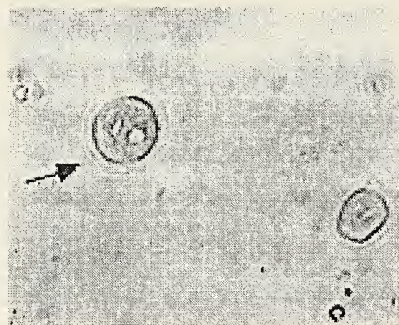


Figure 14. *Isospora* oocyst, 400x.

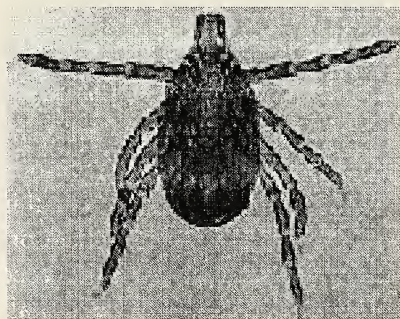


Figure 15. The ventral view of male tick, *Ixodes* sp., 100x.

analysis of the dead snakes in the present study showed most of high mortality rate is due to parasitic infection in these snakes. Parasitic infection in snakes from different countries in the Asian region (Ambu et al., 1990; Fisthal and Kuntz, 1964; Kagei, 1972; Kagei and Kifune, 1977; Tat et al., 1980) has also been reported. The distribution of endoparasitic fauna has been reported for a large number in Malaysian snakes species (Ambu et al., 1990). In the present study, *Kalicephalus laticaudae* was found in many more species of venomous snakes from Thailand then compared with the rest of Southeast Asia. Only one adult worm of the family Gnathostomatidae was found in GI tract of *Lycodon laoensis* and was identified as *Tanqua tiara*. Ambu, et al. (1990) found only two male *Capillaria* sp. but in this study, they were found only as eggs in *Trimeresurus albolabris*. The eggs of *Oxyurus* sp. were also found in *Trimeresurus albolabris*. Infection in snakes is probably due to ingestion of fecal contaminated food and water. *Strongyloides* sp. was identified only to genus level be-



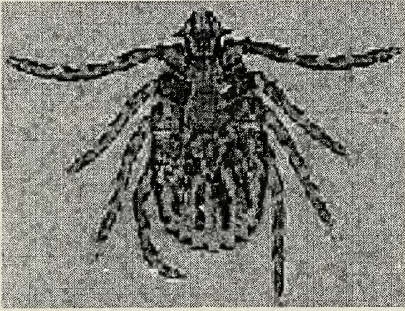


Figure 16. The ventral view of male tick, *Haemaphysalis* sp., 100x.



Figure 17. The dorsal view of female tick, *Aponomma* sp., 200x.

cause only eggs and larva were found in *Naja kaouthia*.

Only one specie of cestode was recovered in both venomous and non-venomous snakes especially the larval stage called sparganum. Sparganum was found mostly in venomous snakes from South Thailand. Adult worms are usually found in the small intestine of dogs and cats but the larval stage can be found in the muscle of snakes, frogs and fishes. The adult worm, *Spirometra reptans*, has been associated with sparganosis in humans who ingest either raw fish or raw snake. The larval stage can migrate to the brain, spinal cord and the other parts of the body (Chang et al., 1999; De Roodt et al., 1993; Fung et al., 1989; Kim et al., 1996; Kron et al., 1991; Kudesia et al., 1998; Landero et al., 1991; Norman and Kreutner, 1980; Tsai et al., 1993). No information is available concerning sparganum in Malasian and Philippines' snakes (Ambu et al., 1990; Fisthal and Kuntz, 1964; Kagei and Kifune, 1977). One trematode identified as *Paradiastomum* sp. (Kagei et al., 1972) has been found in snakes in Japan. It has an indirect life cycle with one or several intermediate hosts, such as snails, frogs and fishes. This parasite actually lives in both the bile duct and gall bladder and it will pass to the GI tract in case of heavy infestation. One species of Acanthocephala was recovered from venomous and non-venomous snakes; *Acanthocephalus ranae* has an indirect life cycle. Snakes serve as temporary or secondary intermediate hosts.

*Leiperia gracilis* (tongue worm) was found in the vomitus of Blood Python (*Python curtus*). Snakes are probably infected by feeding on primary hosts containing juvenile stages, such as fishes, amphibians, small mammals and rarely birds.

*Isospora* is genus of coccidia that affects the epithelial cells of the intestine, the biliary system, and the kidney. It has a direct life cycle. *Naja kaouthia* and *Daboia russelii siamensis* are infected by ingestion of oocyst contaminated food and water. The clinical signs in animals are anorexia and diarrhea. In severe cases can cause digestive disorders, vomit, dehydration, and hemorrhagic enteritis. (Barnard and Upton, 1994).

In the venomous snakes, hard ticks of the genera *Ixodes sp.*, *Haemaphysalis sp.*, and *Aponomma sp.* were found. They are blood sucking parasite and the cause of anemia and skin damage that can lead to secondary bacterial infection. They also have the potential to transmit hemoprotozoas and viruses to snakes.

Most parasites have an indirect life cycle and snakes serve as the intermediate host. Parasitic infestation in snakes result in variety of effects from mild disturbance to fatality. The balance of parasite-host relationship is far different between wild snakes and captive snakes. Conditions in captivity such as poor husbandry, inadequate diet, and overcrowding can lead to stress that weakens an immune system (Klingenberg, 1993). This preliminary study reveals the distribution of helminthes fauna in a large number of snakes in Thailand. *Kalicephalus laticaudae* infestation is the most prominent found and hypothesized to have caused the death of many snake species examined.

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## New Reptilian Records from Eastern Iowa

The most comprehensive work on the snakes of Iowa was Guthrie (1926), and since that time few publications relating to the herpetofauna of Iowa have been published, except for Klimastra (1950) on the herpetofauna from southeastern Davis County, and Christiansen and Mabry (1985) on the fauna of Iowa's loess hills region. Christiansen and Bailey's (1988a,b) generalized papers on the amphibians and reptiles found within the state. Since that time Bailey and Christiansen (1993) have provided an excellent historical review of early research on the herpetofauna, while a recent publication by Christiansen (1998) focuses on the declining amphibians and reptiles within the state, having been primarily caused by habitat destruction.

Recently a collection of amphibians and reptiles previously housed in the Putnam Museum of History and Natural Sciences was donated to the author by the curator, Dr. Christine S. Chandler, and presently is housed at the Northern Illinois University, Dekalb, Illinois.

In an effort to update our knowledge of the distribution of certain amphibians and reptiles of Iowa, I feel it would be noteworthy to verify the current knowledge of geographical distributions of species found within Eastern Iowa. The majority of these records are at least 50 years old, but still of major importance, as they constitute new records for the state, and should be of historical importance for future studies

### Sauria

*Cnemidophorus s. sexlineatus* (Eastern Six-lined Racerunner). MUSCATINE CO: Muscatine, Bloomington twp. August 13, 1961. Bill Webb and Peter Peterson. (RE 064-66) HDW-NIU 1723-1725.

*Eumeces fasciatus* (Common Five-lined Skink). JONES CO: 4 mi. West of Canton, Clay twp. August 6, 1961. Bill Webb. (RE 048) HDW-NIU 1716; Bill Webb and Robert Schroeder. August 6, 1961. (RE 059-62). HDW-NIU 1718-1720. August 8, 1961 (RE 63) HDW-NIU 1721.

### Serpentes

*Coluber constrictor foxii* (Blue Racer). JACKSON CO: Maquoketa, Maquoketa twp. August 9, 1964. Bill Webb. (RE 223) HDW-NIU 1800.

*Diadophis punctatus arnyi* (Prairie Ring-necked Snake). JACKSON CO: Canton, Clay twp. August 6, 1961. Robert Schroeder. (RE 040-41, 058). HDW-NIU 1738-1740; Near Maquoketa, Maquoketa twp. August 1961. Bill Webb. (RE 200-203) HDW-NIU 1741-1744.

*Elaphe vulpina* (Western Fox Snake). SCOTT CO: Princeton, Princeton twp. 1961. Bill Webb. (RE 005) HDW-NIU 1876.

*Heterodon nasicus nasicus* (Plains Hog-nosed Snake). MUSCATINE CO: Muscatine, Bloomington twp. Date unknown. Jim Peck. (RE 004) HDW-NIU 1776. This species is listed as Endangered in Iowa.

*Lampropeltis triangulum triangulum* (Eastern Milksnake). SCOTT CO: Davenport, Davenport twp. 1966. Bill Webb. (RE 046) HDW-NIU 1748; September 6, 1960. Harold Heeschen. (RE 108) HDW-NIU 1750; July 1962. C.B. Rupp. (RE 219) HDW-NIU 1749.

*Nerodia rhombifera rhombifera* (Northern Diamond-backed Watersnake). LOUISE CO: 5 mi. S. Muscatine. September 5, 1961, 20 newborn. D.G. Herold. (RE 203) HDW-NIU 1891-1910; MUSCATINE CO: Muscatine, Bloomington twp. September 5, 1961. Bill Webb. HDW-NIU; July 25, 1960, D.G. Herold. (RE 103) HDW-NIU 1889.

*Nerodia sipedon* (Northern Watersnake): SCOTT CO: Duck Creek Park, Davenport, Davenport twp. September 1960. Bill Webb. HDW-NIU 1836; Princeton slough, Princeton, Princeton twp. September 8, 1961. D.G. Herold. 13 newborn. (RE 198) HDW-NIU; MUSCATINE CO: Muscatine, Bloomington twp. July 25, 1960. D.G. Herold. (RE 089, 092) HDW-NIU 1831, 1837.

*Opheodrys vernalis* = *Liochlorophis vernalis*. (Smooth Greensnake). SCOTT CO: Davenport, Davenport twp. 1961. Bill Webb. (RE 008-9) HDW-NIU 1711-1713; Jim Peck (RE131) HDW-NIU 1713. Christiansen (1998) notes that populations have suffered declines, and presently has been found on "several state and country preserves," and is "worthy of concern." LeClere (1998) states, "uncommon, and having suffered from habitat destruction, pesticides, and progression." This species is presently listed as Threatened in Iowa.

*Pituophis catenifer* (Pacific Gophersnake). JACKSON CO: Maquoketa, Maquoketa twp., Date unknown. Robert Schroder. (RE-055-57). HDW-NIU 1735-1737; August 27, 1959. Robert Schroder (RE 071) HDW-NIU 1911.



*Regina grahamii* (Graham's Crayfish Snake). LEE CO: Ft. Madison, Washington twp. Date unknown. David Loren. (RE 087) HDW-NIU 1777.

*Storeria dekayi wrightorum* (Midland Brown snake). SCOTT CO: Davenport, Davenport twp. 1961. Bill Webb. (RE 073) HDW-NIU 1809; May 12, 1961. Pat Reilly. (RE 129) HDW-NIU 1805; October 5, 1961. Lloyd Abbot (RE 208) HDW-NIU 1804; October 10, 1965. George R. Cross. (RE 246) HDW-NIU 1821. Princeton, Princeton twp. October 27, 1960. D.G. Herold. (RE 127, 130) HDW-NIU 1806-7; September 27, 1964. D.G. Herold. (RE 225) HDW-NIU 1823

*Thamnophis radix* (Plains Gartersnake). SCOTT CO: Princeton, Princeton twp. October 1960. D.G. Herold. (RE 124) HDW-NIU 1766; Davenport, Davenport twp. June 1960 Keith Oden. (RE 122-23, 125) HDW-NIU 1768, 1765 and 1764; Davenport, Davenport twp. October 10, 1965. George R. Cross. (RE 246A) HDW-NIU 1912-1918.

*Thamnophis sirtalis parietalis* (Red-sided Gartersnake). SCOTT CO: Princeton, Princeton marsh, Princeton twp.. August 2, 1964. Bill Webb. HDW-NIU; November 23, 1960, D.G. Herold (RE 117, 120) HDW-NIU 1757, 1760;

*Crotalus horridus* (Timber Rattlesnake). JACKSON CO: Bellevue, Bellevue twp. September 7, 1967. Art Stuart. These are listed as one week old neonates. (RE 260) HDW-NIU 1789-1797; JONES CO: 8 mi. S.E. of Monticello. June 25, 1961. Galen Heim. (RE 215) HDW-NIU 1705.

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## Status of *Pseudacris feriarum* in Prince William Forest Park, Prince William County, Virginia

An amphibian monitoring program was initiated in Prince William Forest Park (PRWI), a unit of the National Park System, in 1998 (Pollio 2000). Habitat location and characterization, anuran call surveys, breeding surveys, and larval sampling led Resource Management staff to identify native species that were uncommon or not found within the park. The following year a study was initiated to focus on one of these species, *Pseudacris feriarum*, the upland chorus frog. As a result, intensive nocturnal and diurnal field surveys were conducted during the peak breeding period at prime habitat locations to determine the population size and reproductive status of *P. feriarum*.

*P. feriarum* is a small anuran (19B37 mm SVL) that ranges from northern New Jersey to the Florida panhandle in the east and west to East Texas and southeast Oklahoma (Conant and Collins 1991). It is known to occur throughout Virginia with greater density in the Piedmont and upper Coastal Plain (Martoff, et al 1980). Ernst, et al (1997) states that this once common species is disappearing from Northern Virginia most likely due to increased urban development, habitat loss, or erratic weather patterns. This species can be found near moist woodland habitats and breeds annually in small ephemeral ponds, roadside ditches, and other suitable wet habitats. Suitable breeding habitat for *P. feriarum* is defined by Mitchell (1998) as grassy areas associated with shallow water in wetlands without fish, including roadside ditches and vernal pools in open fields. Breeding can occur from February to May in northern Virginia. Males typically begin chorusing in late February and females arrive at ponds within two weeks under normal environmental conditions (Briggs 1994). Most females arrive at sites over a 2-3 day period for communal breeding and deposit clusters of 40B60 eggs attached to vegetation. Eggs hatch within 3-4 days and transformation occurs within two months. Several studies on a closely related species (*Pseudacris triseriata*) indicate that water depth at time of oviposition plays a significant role in determining survival rate (Webb 1994, Hecnar and Hecnar 1999). Metamorphosis can be impacted by availability of food and predator density (Travis 1981, Pearman 1995, Briston and Kissell, 1996).

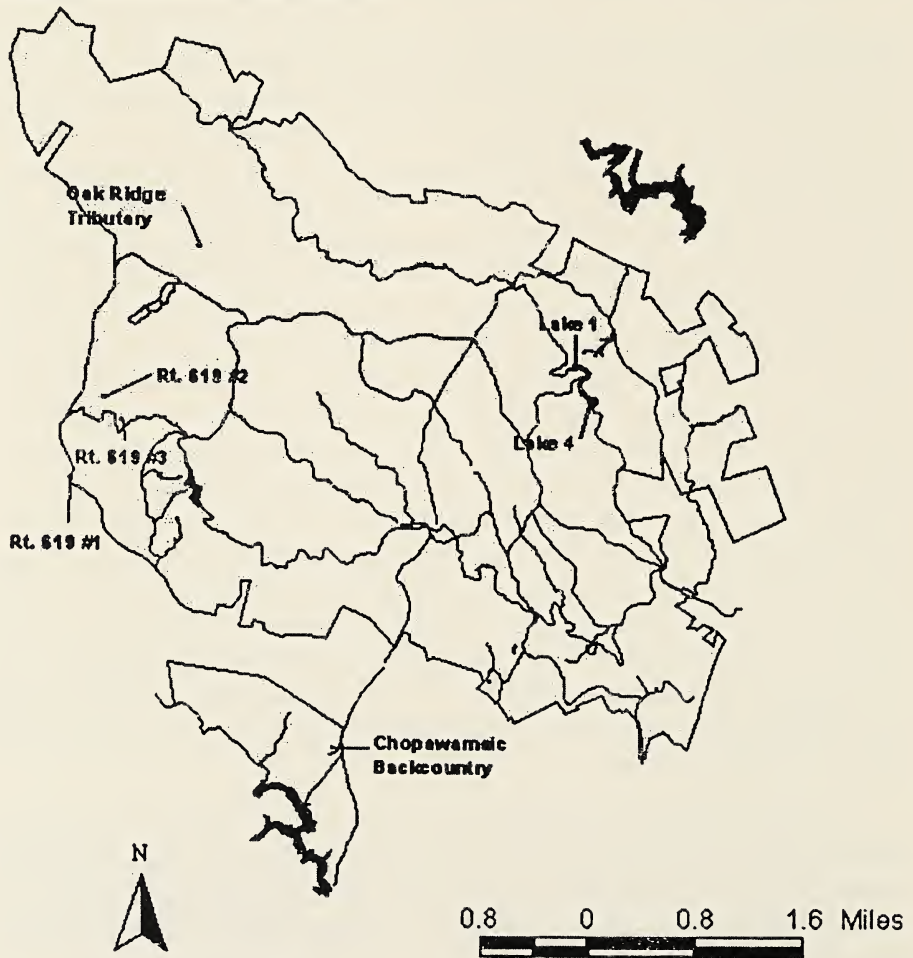
Resource Management staff began this project by identifying *P. feriarum* breeding sites within park boundaries based on historic records and suitable habitat. Of the 47 amphibian breeding sites identified during surveys conducted in 1999, only four were selected as having suitable habitat; Rt. 619 # 1,



Rt. 619 #2, Rt. 619 #3, and Oak Ridge Tributary (Fig. 1). Two additional sites, Lake 1 and Lake 4, were selected as potential sites based on habitat, and the Chopawamsic Backcountry area was selected based on an historic record of occurrence. All other historic records within the park (Table 1) could not be used due to the lack of specific locality information.

Visual and auditory surveys were performed weekly beginning in mid-February 2001 and were increased to two times per week in mid-March. Calls were classified into four groups: no calls (0); individuals (1); individuals with

Figure 1. Map of Prince William Forest Park, Triangle, Virginia, showing *Pseudacris feriarum* sample sites.



limited overlap (2); and chorus, defined as numerous individuals calling with complete overlap (3). After the first cali was heard at a given site, daily surveys were performed to identify amplexing couples, egg masses, or any sign of reproduction. Table 2 describes the sites and dates where *P. feriarum* was observed, as well as the calling frequency. This species was not observed at Lake 1, Rt. 619 #3 and the Chopawamsic Backcountry area. Only one male was heard calling at Lake 4 on 11 April 2001. Oak Ridge Tributary had a maximum of three individuals calling at any one time and Rt. 619 #2 had limited overlap males calling for approximately three weeks. Rt. 619 #1 was the only site where a full chorus was observed, yet it was completely dry by 11 April 2001, less than one week after the last chorus was heard. No females were observed at any site and no site had evidence of reproduction. Larval dipnetting was performed biweekly at the three sites that maintained water, but none were found.

Resource Management staff had been concerned about the lack of presence of *P. feriarum* in PRWI during the anuran call surveys and this concern has increased as a result of this study. Historic records from PRWI are incomplete and do not provide adequate information to determine historic population density, however the literature suggests that this species was once common in this area (Ernst, et al 1997, Martoff, et al 1980). It is reasonable to assume that the main reason for PRWI having few populations is lack of suitable habitat, but whether this lack of habitat is natural or due to human encroachment has yet to be determined. Only six sites were chosen for this study based on the habitat requirements of the species, and the only site chosen for historic reasons lacked suitable habitat. The prime site for *P. feriarum* is Rt. 619 #1, which is a heavily traveled road, and this impact is undoubtedly af-

Table 1. Historic Records of *Pseudacris feriarum* in PRWI

Date	Site	Description	Reference
3/1961	PRWI	None	FNH (observer=s initials)
5/1961	PRWI	None	FNH
6/1961	PRWI	None	FNH
7/1961	PRWI	None	FNH
3/1963	PRWI	None	HEM
4/27/1997	PRWI	Vernal pool	Mitchell 1998

Table 2. *Pseudacris feriarum* Breeding Sites Surveyed in 2001

Site	Dates Observed	Description	Fish Present	Species Present
Rt. 619 #1	3/24/01-4/7/01	Vernal Pond	No	Yes - chorus
Rt. 619 #2	3/18/01-4/7/01	Beaver Impoundment	Yes	Yes- limited overlap
Rt. 619 #3	n/a	Riparian Pool	Yes	No
Oak Ridge	3/22/01-4/4/01			
Tributary	5/9/01	Riparian Pond	Yes	Yes- individuals
Lake 1	n/a	Lake	Yes	No
Lake 4	4/13/01	Lake	Yes	Yes - one individual
Chopawamsic				
Backcountry	n/a	Vernal Pond	No	No



fecting the population size and breeding success. Males calling there are forced to compete with the sound of traffic and adults migrating to the site may have to cross the road. There is high interspecies competition for breeding sites and the calls of other species have been said to drown out the calls of *P. feriarum* during years with erratic weather patterns where breeding seasons overlap (Briggs 1994, Webb 1994). Duellman and Trueb (1986) stated that mating success in males is low, around 17.2%, and that coupled with environmental and human pressures has impacted *P. feriarum* populations throughout their range.

This study indicates that the population of *P. feriarum* in PRWI is in serious decline. Further investigation is needed to determine the factors affecting this population and to identify management strategies to maintain and improve its numbers. Continued monitoring will document population trends; but more intensive habitat surveys, coupled with calling surveys conducted in early February may assist in identifying additional populations within the park. Drift fences with pitfall traps should be constructed around known sites and adults subjected to mark-recapture analysis to determine population size. Without intervention, *P. feriarum* will soon disappear from this part of its historic range.

### Acknowledgment

We would like to thank Jennifer A. Lee, National Park Service, for acquiring and rectifying geographic data related to this survey, and producing the map depicted in Figure 1. We would also like to acknowledge the National Park Service, National Capital Region, Washington, D.C., for providing funding in support of this investigation.

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*Sandra L. Kilpatrick, Research Contractor (formerly National Park Service, Triangle, VA)*

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## A New Snake Related to *Sibon sanniola* (Serpentes: Dipsadidae) from Los Tuxtlas, Veracruz, Mexico

Gonzalo Pérez-Higareda, Marco A. López-Luna and Hobart M. Smith

### Abstract.

*Sibon linearis* is described from Balzapote, Veracruz, Mexico. It most closely resembles *S. sanniola*, but is ~400 km from the nearest known locality for that species, has a linear instead of blotched pattern, and 20 vs 23-26 dentary teeth.

A snake found dead on a trail a few years ago near Balzapote, Veracruz, Mexico, appears to represent a species similar to *S. sanniola*, endemic to the Yucatán peninsula, including Belize (Kofron, 1990; Lee, 1996; Campbell, 1998). The specimen from Los Tuxtlas has a strikingly distinctive dorsal pattern and a lower number of dentary teeth (20 vs 23-26) than *S. sanniola* (Kofron, 1990).

Los Tuxtlas is an area of strong endemism, and is some 400 km from the nearest known locality, in Campeche, for *S. sanniola*. Given also the cited differences from that species, we regard the specimen from Los Tuxtlas as representative of a hitherto unknown species that we here name

### *Sibon linearis* sp. nov.

**Holotype.** Universidad Nacional Autónoma de México – Los Tuxtlas (UNAM-LT) 1796, an adult female from Balzapote, municipality of San Andrés Tuxtla, Veracruz, Mexico, 100 m. August 1983, GPH collector. The left side of the head is crushed, and the posterior infralabials were eaten by ants. Otherwise the specimen is in good condition.

**Diagnosis.** Similar to *S. sanniola* but with a lineate instead of blotched pattern, and 20 vs. 23-26 dentary teeth.

**Description of holotype.** Dorsal scale rows 15-15-15, smooth, without apical pits; ventrals 155; subcaudals 70; anal single; preoculars 3-3; postoculars 2-2; loreals 1-1; temporals 2-2; supralabials 9-9; a postmental separating the first pair of infralabials; eyes very large, diameter over 3 times distance from lip. Maxillary teeth 11, dentary 20. Total length 311 mm, SVL 225 mm, tail 86 mm. Body not laterally compressed.

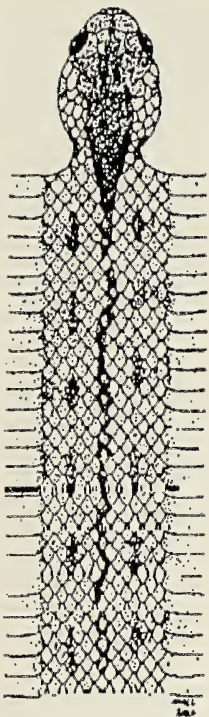


Fig. 1. Dorsal pattern of head and anterior part of the body of UNAM-LT 1796.

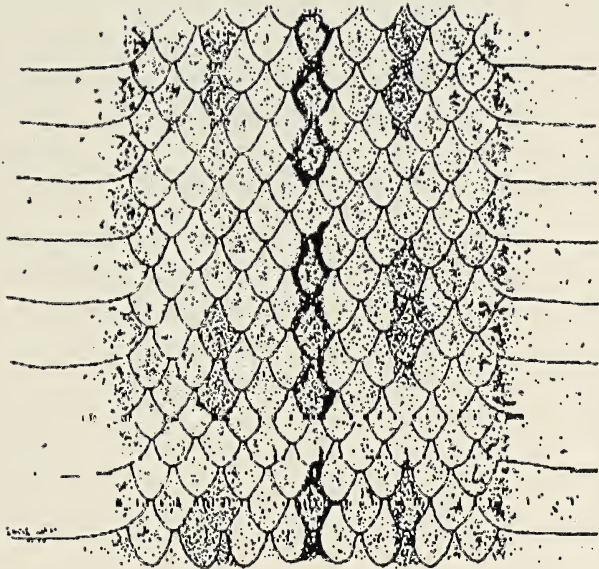


Fig. 2. Midbody pattern of UNAM-LT 1796.

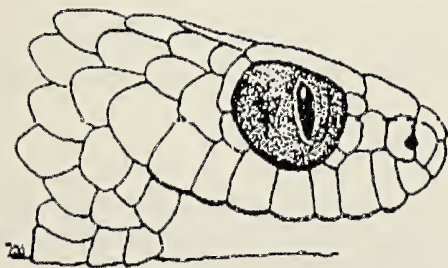


Fig. 3. Lateral head scales of UNAM-LT 1796.

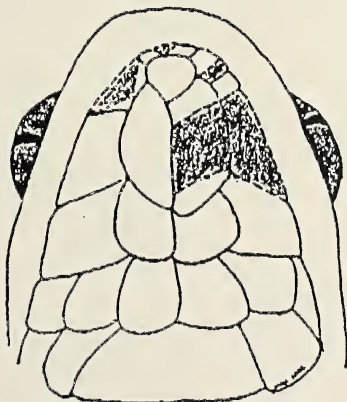


Fig. 4. Ventral head scales of UNAM-LT 1796. The shaded areas indicate ant-damage.

Body light brown, slightly darker on flanks; a narrow, irregular, continuous dark stripe along the vertebral scale row from the rear nape to about a sixth of the body length, extending here and there onto the adjacent edges of the paravertebral scale rows. Posteriorly, the stripe continues interrupted on the vertebral scale row, in a series of short streaks three scales long, separated from each other by an interspace of one scale length; scales of each streak dark-edged, light-centered. On the fourth scale row is a series of darker brown streaks 2-3 scales in length, separated from each other by a space 2-3 scales in length; they are diffuse on the tail.

Superior part of head brown, with a median reddish-brown stripe from rostral to parietals, expanding on the posterior part of the head and becoming six scales wide on mid-nape; its width diminishes posteriorly to fuse with the vertebral stripe on the rear part of nape. Dorsal and lateral head scales, except for the supralabials, heavily pigmented; supralabials yellowish, their ventral borders dark brown; a small dark spot on side of neck, covering 2-3 scales. The head is pale yellow ventrally, with scattered, dark pigmentation. Venter light gray in preservative, weakly pigmented, more so on ends of ventrals and in some areas onto the first dorsal scale row.

**Comments.** This appears to be a terrestrial species, as are other species of *Sibon*. The type was found in a tropical rain forest about two km from the coast.

The name *linearis* is a Latin word meaning "of a line."

The accompanying drawings were prepared by MALL.

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## Book Review

*Amphibians and Reptiles of Pennsylvania and the Northeast*, by Arthur C. Hulse, C.J. McCoy and Ellen J. Censky. 2001. Cornell University Press, Ithaca, NY 14850. x + 419 pp., 133 color plates, 83 maps. Hardcover. US\$39.95. ISBN 0-80143768-7.

While most field guides are fairly standard in subject and content matter, giving only brief descriptions, and natural history notes, this book goes beyond that stage, and provides detailed information on natural history and ecology for each of the 83 species found within the northeastern states. Where information is lacking on reproduction and general natural history for a specific species in Pennsylvania, information has been provided from other sources within the species range, giving both professional or amateur herpetologists a clearer picture of the life history of each species.

It is with regret that C. J. McCoy "Jack," co-author of this book died on July 7, 1993, and was instrumental in the production of this book, having previously published the "Amphibians and Reptiles in Pennsylvania: Checklist, Bibliography, and Atlas of Distribution" (1982).

The book, as stated in the Preface, was written for a broad audience, and directed both to professional and amateur herpetologists, students, and anyone having a love for nature, and passion to learn more about the organisms they might encounter in the field. The book opens with a table of contents, followed by a preface and acknowledgments. The introduction provides information on landform patterns, climate, vegetation, along with explanations regarding family, genus, species, standard and common names, descriptions, comments on confusing species, habitat and habits, reproduction, distribution, discussed under each species account. This is followed by a brief note on observing and collecting amphibians and reptiles, and a highly illustrated 25 page key to the amphibians and reptiles of Pennsylvania and the Northeastern United States. The individual species accounts form the bulk of the book, with 322 pages devoted to 83 species, and preceded by an appendix of Pennsylvania species mensural and reproductive data, which includes statistical data that provides mean length for sexually mature individuals and some neonates, range, sample size, statistical comparison between male and female, and size at maturity, along with reproductive data on clutch size. Individual species accounts are subdivided into sections labeled description,

*News and Notes*

which provides information on general morphology, sexual size dimorphism, tadpoles, confusing species, following by habitat and habits, and reproduction.

Following the key are a set of 133 color photographs arranged four per page. Overall the plates are excellent, but plate 132 of the Timber Rattlesnake is extremely dark, while plate 100 of the eastern worm snake, and plate 104 of the northern black racer are of rather poor quality. Plate 94 showing a melanistic northern coal skink is of exceptional quality.

Topographical errors are few but on page 133, New Jersey is spelled in lower case letters and with is spelled ith (=with) in the tadpole *Rana virgatipes* description, page 210. Earnst 1970b (=Ernst 1970b) on page 210, and on p. 414 Yearicks et al. (1981) give a title, but lacks the journal citation. *Necturus maculosus* is cited as not occurring in southwestern Wisconsin, although this species is occasionally taken during winter and early spring months in the Mississippi River by commercial fishermen, while *Hemidactylium scutatum* has the range cited as extending through "central New England and southern Ontario to Wisconsin," which gives the impression that this species does not occur in Illinois, although relict populations occur within northern and central portions of the state.

In spite of only minor errors, this book is exceptionally well done, and a must for anyone interested in the herpetofauna of eastern United States, and particularly those interested in Pennsylvania. It should remain an authoritative treatise for many decades to come.

The glossary, bibliography, and index close out this excellent volume. The bibliography cites over 700 references, although the literature search was discontinued in 1998, as only one reference is cited for 1999.

Harlan D. Walley, Department of Biology, Northern Illinois University,  
DeKalb, Illinois 60115.



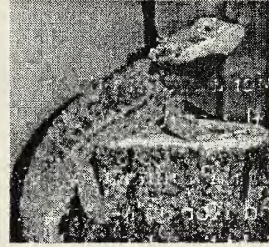
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**Errata:**

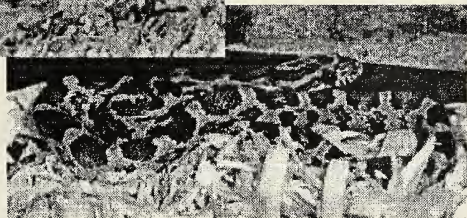
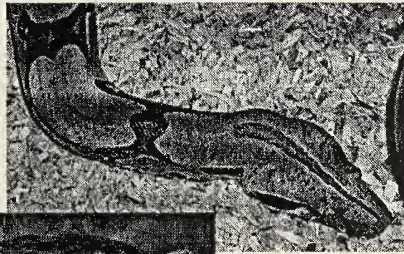
Paulino Ponce Campos apologizes due to a mistake in the name of the thier author in the paper on pages 18-21 in Volume 37, Number1. Following is the correct citation:

Paulino Ponce Campos, Sara M. Huerta Ortega, Carlos noguiera Gómez and Hobart M. Smith. 2001. Natural history notes on the southern plateau night lizard, *Santusia sanchezi*. Bullet of the Maryland Herpetological Society. Voluine 37 Number 1. 18-21.

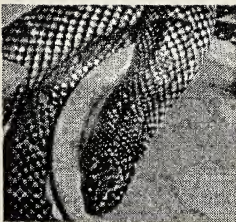
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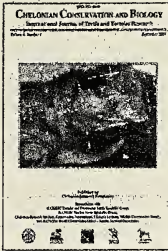
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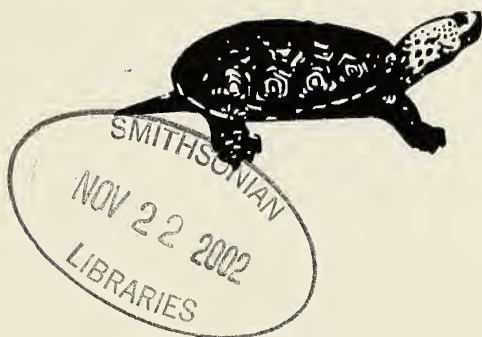
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Volume 38 Number 3

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## Stomach Content Analysis of 13 North American Toad Species

Kiersten Cook

Sam Droege

Arthur Remington Kellogg

### Abstract

New summaries of the diets of 13 species of North American toads are presented from stomach contents analyses.

Diet is a fundamental facet of a species' life history; basic information, essential to all ecological studies and conservation plans. From a knowledge of diet comes insight into a species' evolution, morphology, physiology, dietary specialization, food niche, habitat requirements, activity periods, vulnerability to food base changes; and resource partitioning among species, across habitats, and over time.

The literature suggests toads are primarily nocturnal, opportunistic foragers, with diets rich in ants and beetles (Bragg 1940; Smith and Bragg 1949; Clarke 1974; Duellman and Trueb 1986). An excellent summary of what was known of toad diet prior to 1974 may be found in Clarke (1974). Subsequent major works on toad diet include studies by Toft (1980 a; b; 1985), Dimmit and Ruibal (1980), Flowers and Graves (1985), and Barrentine (1991).

In contrast to other North American anurans, toads have the ability to eat arthropods normally found unpalatable to most species (eg. beetles, ants, wasps, and sowbugs, Clarke (1974)). Toads' catholic tastes, ubiquity, and local abundance has caused biologists in the past to view toads as potential pest control agents, with the multiple introduction of the cane toad (*Bufo marinus*) as prominent case-in-point. In this note, we capitalize on some of the early economic works of these biologists and present previously unpublished stomach content data for 13 species of toads (*Bufo* sp.). The data presented in this paper stand apart from most previous studies, in that collections were made across much of the species' ranges and throughout most of their activity periods. These data offer, to our knowledge, the largest published sample sizes for the diets of *B. alvarius*, *B. boreas*, *B. americanus*, *B. canorus*, *B. fowleri*, *B. hemiophrys*, *B. punctatus*, and *B. valliceps* and the only record of diet for *B. debilis*.

The specimens used in this paper came primarily from museum and university collections, with collection dates ranging from approximately 1852-1922. The US Biological Survey's technician, Remington Kellogg (later to become the Assistant Secretary (Science) of the Smithsonian), processed most of the toads, although, F. E. L. Beal and C. W. Leister, also at the Bureau, did some analyses. While we found no explicit records of the methodology used to quantify stomach contents, we do not suspect that Kellogg's methods differed from those being used throughout that laboratory, in particular for birds (Martin, 1949). The rationale for both bird and toad diet studies was to assess these animal's economic significance in the control of noxious insects (Kellogg 1922; US Biological Survey 1934).

Stomach contents were sorted to phylum, subphylum, order, or family level. Proportions were calculated using the food item's volumetric displacement of water. Gravel and vegetation were also included in the volume. For each specimen a stomach contents card was filled out, giving the species' name, life stage; the date, month and year of collection, collection site, altitude, and the name of the collector, (however, not all of these fields were recorded consistently). In most cases the date of collection was also provided, along with the name of the museum or university that supplied the specimen. Apart from two popular government tracts on the usefulness of toads to humanity (Kellogg 1922; 1928), in which data for *B. americanus* were presented, these data have never been published. The original cards are housed at Patuxent Wildlife Research Center and are available for use by appointment with the second author.

Kellogg tabulated the data for 13 species in the early 1920's. Those tables were discovered in storage at the Patuxent Wildlife Research Center, double checked against the original cards, updated taxonomically and mathematically, and are presented here. A future statistical analysis of the original data cards is planned.

Tabulations of the percentage by volume of the stomach contents are presented in Table 1. The data are divided into Spring (February - June) and Summer (July - September) diets to accentuate major seasonal differences. In Table 2 we summarize the distribution of the records for each species by the States and Countries in which the collections were made and the number of collections made per month, to document the extent of collections. Diets were not separated by age class or gender, although a majority of specimens were identified as adult males.



Table 1. Diets of 13 North American toad species (*Bufo* sp.) collected across N. America from 1852 to 1922, presented as percent of the total stomach volume for n specimens. Families are indented. See text for months that represent Spring and Summer for each species (Spr. = Spring, Sum. = Summer).

	<u><i>B. alvarius</i></u>	<u><i>B. americanus</i></u>		<u><i>B. boreas</i></u>		<u><i>B. cognatus</i></u>	
	Month	Spr.	Sum.	Spr.	Sum.	Spr.	Sum.
	<u>unknown</u>						
n	15	160	245	58	178	19	27
ANNELIDA (Phylum)	0	0.96	0	0	0	0	1.30
MANDIBULATA (Subphy)	0.93	4.83	4.28	7.64	4.07	0.79	0
ISOPODA (Class)	0	1.38	0.30	4.50	0.2	4.21	0
AMPHIPODA (Class)	0	0	0	2.03	0.39	0	0
INSECTA (Class) (misc.)	0.80	0.38	1.84	2.64	2.83	0.89	0.19
THYSANURA (Order)	0	0	0	0	0	0	0
ORTHOPTERA (Order) (misc.)	1.87	0.59	2.07	0.36	0.59	2.37	0
Caelifera/Ensifera (Suborder)	2.47	0.75	2.72	0.07	5.58	1.26	4.74
Gryllidae	2.47	0.44	0.97	0.50	1.40	4.68	1.78
ISOPTERA (Order)	8.20	0	0	0	0	0	1.89
DERMAPTERA (Order)	0	0	0	0.05	0.07	0	0.07
HEMIPTERA (Order)	0.13	3.31	0.79	2.03	1.84	1.74	3.63
COLEOPTERA (Order) (misc.)	1.67	5.63	3.72	4.66	5.31	2.68	3.44
Carabidae	21.27	14.96	20.36	14.62	7.44	11.79	19.15
Hydrophilidae	1.33	0.61	0.14	0.33	0.60	3.63	0.04
Staphylinidae	0	0.70	1.46	1.22	2.06	0.84	0.70
Lampiridae / Cantharidae	0	0.37	0.26	1.67	0.30	0	0
Elateridae	0.07	2.86	2.03	1.12	1.67	0.68	1.22
Coccinellidae	0	0.30	0.34	1.02	1.40	0.53	0.04
Tenebrionidae	13.53	2.08	1.58	2.71	2.94	8.37	4.26
Scarabaeidae	14.80	10.79	5.22	2.55	2.25	9.63	13.19
Cerambycidae	4.73	0.16	0.49	0.78	0.78	0	0
Chrysomelidae	0	1.20	0.80	0.97	0.51	3.05	6.30
Curculionoidae (Superfamily)	0	3.84	4.24	2.22	2.24	3.84	1.26
TRICHOPTERA (Order)	0	0.16	1.75	0.34	2.61	0	0
LEPIDOPTERA (Order)	0	4.91	3.14	7.74	4.64	11.26	5.78
DIPTERA (Order)	0	2.23	1.43	4.66	4.75	1.68	5.52
HYMENOPTERA (Order) (misc.)	2.67	1.45	1.53	2.91	5.27	1.37	0.89
Formicidae	8.53	17.90	23.24	10.98	24.17	18	23.26
ARACHNIDA (Subphylum) (misc.)	11.87	0	0	0.26	0.91	0	0.30
PHALANGIDA (Order)	0	0.01	1.80	1.34	0.58	1.32	0.70
ACARINA / ARANEIDA (Order)	2.67	5.50	1.54	3.36	2.02	5.37	0.37
MOLLUSCA (Phylum)	0	2.36	0.84	0.02	0.57	0	0
Lizard, Bird, Crustacea	0	0	0	0	0	0	0
Toad skins	0	0.63	0.95	0	0	0	0
Animal matter (misc.)	0	1.02	0.94	0	0	0	0
Vegetable food	0	7.41	8.73	14.69	10.19	0	0
Rocks and gravel	0	0.30	0.33	0	0	0	0



Table 1. Continued.

	<i>B. canorus</i>		<i>B. speciosus</i>		<i>B. debilis</i>		<i>B. fowleri</i>	
	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>
n	7	26	16	22	6	12	115	82
ANNELIDA (Phylum)	0	0	0	0	0	0	0	0
MANDIBULATA (Subphylum)	2.57	0.71	0.44	0.91	0	0	1.92	0.99
ISOPODA (Class)	0	0	6.31	0.68	0	0	0.63	1.83
AMPHIPODA (Class)	0	0	0	0	0	0	0	0
INSECTA (Class) (misc.)	1.14	7.28	0.88	1.91	0	0	0.30	0.72
THYSANURA (Order)	0	0	0	0	0	00	0	0
ORTHOPTERA (Order) (misc.)	0	0	0	0.45	0	0	0.36	3.37
Caelifera/Ensifera (Suborder)	0	0	0	2.00	0	0	1.17	0.52
Gryllidae	0	0	1.25	0.05	0	0	2.40	9.11
ISOPTERA (Order)	0	0	2.88	6.55	28.29	0	0.10	0
DERMAPTERA (Order)	0	0	0.13	1.68	0	0	0	0.12
HEMIPTERA (Order)	0.57	1.73	0.81	2.09	3.29	0.83	2.43	1.61
COLEOPTERA (Order) (misc.)	0	2.39	0.31	3.28	0	0.17	1.38	2.21
Carabidae	16.57	12.74	32.50	15.79	0	0	22.73	32.29
Hydrophilidae	1.14	1.70	0	0	0	0	0.10	0
Staphylinidae	3.71	0.81	0.06	0.27	0	0	0.42	0.16
Lampiridae / Cantharidae	0	0.20	0	0.14	0	0	0.54	0
Elateridae	3.86	2.01	0.81	2.18	1.43	0	5.21	2.96
Coccinellidae	2.86	2.42	0.06	0	0	0	1.34	1.06
Tenebrionidae	4.00	0.97	0.38	4.78	0	0.17	3.14	1.11
Scarabaeidae	0	0.05	8.88	18.29	6.43	0	16.39	9.05
Cerambycidae	0	0	0	0	0	0	1.06	0.73
Chrysomelidae	0	0.25	0.81	1.68	0	0	0.70	0.83
Curculionoidea (Superfamily)	0.57	0.64	1.38	1.14	0	0	6.46	4.62
TRICHOPTERA (Order)	0	0.15	0	0.05	0	0	0.01	0.61
LEPIDOPTERA (Order)	1.00	0.28	5.88	6.28	1.71	0.50	7.03	6.79
DIPTERA (Order)	1.00	13.00	0.81	0.91	0.71	0	1.34	0.74
HYMENOPTERA (Order)								
(misc.)	0.14	1.48	0.13	1.41	0	0	3.26	0.80
Formicidae	56.00	44.24	31.69	23.43	53.86	98.33	16.45	13.70
ARACHNIDA (Subphylum)								
(misc.)	0	0	0	1.77	4.29	0	0.03	0.30
PHALANGIDA (Order)	2.00	1.12	1.56	0.32	0	0	0	1.04
ACARINA/ARANEIDA (Order)	2.86	5.83	2.06	1.96	0	0	2.87	0.85
MOLLUSCA (Phylum)	0	0	0	0	0	0	0	0.21
Lizard, Bird, Crustacea	0	0	0	0	0	0	0	0
Toad skins	0	0	0	0	0	0	0.22	1.66
Animal matter (misc.)	0	0	0	0	0	0	0	0
Vegetable food	0	0	0	0	0	0	0	0
Rocks and gravel	0	0	0	0	0	0	0	0

Table 1. Continued.

n	<i>B. hemiophrys</i>		<i>B. punctatus</i>		<i>B. quercicus</i>		<i>B. terrestris</i>	
	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>	<u>Spr.</u>	<u>Sum.</u>
ANNELEIDA (Phylum)	2.33	0	0	0	0	0	0	0
MANDIBULATA (Subphy)	5.87	0	0	0.53	0.33	0	0.25	0
ISOPODA (Class)	0	0	0	0.59	0	0	1.38	0
AMPHIPODA (Class)	0	3.26	0	0	0	0	0	0
INSECTA (Class) (misc.)	0.07	3.52	2.10	0.47	0.20	0.14	2.48	0
THYSANURA (Order)	0	2.61	0	0	0	0	0	0
ORTHOPTERA (Order) (misc.)	0	0.13	0	0.59	0.45	0	0.93	1.99
Caelifera/Ensifera (Suborder)	0.13	3.74	0	0.30	0.05	0.28	1.26	0.66
Gryllidae	0	0	2.62	0	1.03	0.69	2.11	17.05
ISOPTERA (Order)	0	0	0	21.93	0.04	0	0.01	0
DERMAPTERA (Order)	0	0	0	0	0	0	1.23	0
HEMIPTERA (Order)	0.07	2.48	1.63	6.68	3.87	0.40	2.86	9.60
COLEOPTERA (Order) (misc.)	1.93	9.96	0.06	0.77	2.51	1.81	2.79	3.31
Carabidae	23.13	5.26	2.10	9.34	7.43	2.16	12.23	11.59
Hydrophilidae	0.73	2.17	0	0	0.13	0	4.64	6.62
Staphylinidae	5.07	2.61	30.30	1.06	1.87	0.85	1.01	0
Lampiridae / Cantharidae	1.07	0	0	0	0.17	1.69	0.13	0
Elateridae	3.20	0.74	0	0.35	1.59	0.79	0.86	7.62
Coccinellidae	0.47	0	0	0	0.01	0.09	0	0
Tenebrionidae	0	0.09	30.30	2.84	0.51	0.38	5.81	0.99
Scarabaeidae	13.93	0.35	8.68	2.13	3.35	3.36	12.95	20.36
Cerambycidae	0.27	0.13	0	0	0.08	0	1.31	8.11
Chrysomelidae	5.53	1.52	0	2.07	3.07	0.66	1.60	0.17
Curculionoidea (Superfamily)	6.07	1.26	0	0.83	2.67	5.67	6.02	3.311
TRICHOPTERA (Order)	0.33	0	0	0	0.33	0	0.95	0
LEPIDOPTERA (Order)	6.40	1.22	0.23	0.12	0.25	0.29	6.03	4.97
DIPTERA (Order)	2.73	7.48	1.11	0	3.44	0	7.03	0
HYMENOPTERA (Order) (misc.)	0.40	1.39	0.12	0.18	2.69	0.91	1.04	0.33
Formicidae	17.73	47.57	15.56	40.43	59.36	79.13	14.75	3.31
ARACHNIDA (Subphylum)								
(misc.)	0.07	0.09	0	2.01	0.88	0.34	1.42	0
PHALANGIDA (Order)	0	0.96	0	0	0.27	0	0.41	0
ACARINA / ARANEIDA								
(Order)	1.93	0.70	5.19	1.65	2.09	0.19	4.20	0
MOLLUSCA (Phylum)	0.33	0.78	0	0	0	0.17	2.03	0
Lizard, Bird, Crustacea	0	0	0	0	0	0	0.26	0
Toad skins	0	0	0	5.14	1.33	0	0	0
Animal matter (misc.)	0	0	0	0	0	0	0	0
Vegetable food	0.20	0	0	0	0	0	0	0
Rocks and gravel	0	0	0	0	0	0	0	0

Table 1. Continued

n	<i>B. valliceps</i>	
	<u>Spr.</u>	<u>Sum.</u>
42	67	
ANNELIDA (Phylum)	0	0
MANDIBULATA (Subphy)	4.80	3.70
ISOPODA (Class)	3.47	2.55
AMPHIPODA (Class)	0	0
INSECTA (Class) (misc.)	2.13	0.81
THYSANURA (Order)	0	0
ORTHOPTERA (Order) (misc.)	3.00	4.51
Caelifera/Ensifera (Suborder)	0.30	0.84
Gryllidae	5.46	14.16
ISOPTERA (Order)	1.71	1.57
DERMAPTERA (Order)	1.05	7.16
HEMIPTERA (Order)	3.56	4.09
COLEOPTERA (Order) (misc.)	2.48	2.31
Carabidae	11.09	3.63
Hydrophilidae	1.05	0.15
Staphylinidae	0.33	0.10
Lampiridae / Cantharidae	0.38	0.16
Elateridae	4.05	1.03
Coccinellidae	0.02	0
Tenebrionidae	1.55	1.55
Scarabaeidae	7.12	18
Cerambycidae	1.66	0.34
Chrysomelidae	2.16	0.72
Curculionoidea (Superfamily)	2.93	2.94
TRICHOPTERA (Order)	0	0.61
LEPIDOPTERA (Order)	6.07	3.22
DIPTERA (Order)	1.78	2.49
HYMENOPTERA (Order) (misc.)	0.96	1.51
Formicidae	21.44	15.09
ARACHNIDA (Subphylum) (misc.)	0.14	3.89
PHALANGIDA (Order)	1.59	0.73
ACARINA / ARANEIDA (Order)	3.84	5.60
MOLLUSCA (Phylum)	0.45	0.28
Lizard, Bird, Crustacea	0	0
Toad skins	3.40	0.75
Animal matter (misc.)	0	0
Vegetable food	0	0
Rocks and gravel	0	0



Table 2. States and Countries, number of toads collected in each month; and modal and median year of collection for 13 species of N. American toads (Bufo).

	<u>B. alvarius</u>	<u>B. americanus</u>	<u>B. boreas</u>	<u>B. canorus</u>	<u>B. cognatus</u>
States and Countries	AZ	CAN, DC, IL, IN, IA, LA, MA, MI, MO, NC, NY, OH, PA, VA, WI, WV	AK, CA, CAN, MT, ID, NV, OR, WA	CA (Yosemite Nat=l Park)	AZ, CO, MEX, MT, NE, NM, TX
Feb.	nd	0	0	1	
Mar.	nd	4	0	0	5
Apr.	nd	12	10	0	0
May	nd	51	15	4	2
Jun.	nd	93	33	3	11
Jul.	nd	170	115	22	15
Aug.	nd	60	45	3	7
Sept.	nd	15	18	1	5
Range of years	1892-1917	1853-1922	1855-1920	1915-1922	1852-1920
Modal year	1917	1919	1919	1915	1893&1920
Median year	1914	1907	1911	1915	1913

Table 2. Continued

	<i>B. speciosus</i>	<i>B. debilis</i>	<i>B. fowleri</i>	<i>B. hemiophrys</i>	<i>B. punctatus</i>
States	AZ, MEX, TX	TX	NJ, AL, DC, GA	ND	AZ, CA, TX
Feb.	0	0	0	0	0
Mar.	1	0	17	0	5
Apr.	1	4	10	0	4
May	7	1	27	0	3
Jun.	7	2	61	14	0
Jul.	19	12	45	18	12
Aug.	2	0	29	5	2
Sept.	1	0	8	0	2
Range of years	1883-1919	1902-1916	1853-1921	1904-1920	1852-1919
Modal year	1916&1917	1916	1917	1915	1882
Median year	1907	1916	1917	1915	1891

Table 2. Continued

	<u><i>B. quercicus</i></u>	<u><i>B. terrestris</i></u>	<u><i>B. valliceps</i></u>
States	AL, FL, GA	AL, FL, GA, SC	GUAT, LA, MEX, TX
Feb.	0	4	6
Mar.	5	2 (Feb.+Mar.=80)	0
Apr.	11	6	4
May	19	6	0
Jun.	40	8	23
Jul.	54	0	5
Aug.	4	0	10 (Jul.+Aug.=19)
Sept.	0	0	0
Range of years	1891-1922	1875-1922	1853-1923
Modal year	1922	1901	1923
Median year	1921	1901	1918



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## Cephalic Dichotomy in the Mangrove Salt Marsh Snake, *Nerodia clarkii compressicauda* (Colubridae: Natricinae)

There have been more than 100 snake taxa reported to have some type of body element duplication (Cunningham, 1937; Smith and Perez-Higareda, 1988; Pefaur and Sierra, 1995). Smith and Perez-Higareda (1988) proposed seven separate classifications regarding specific terminology for body element duplication including craniodichotomy, prodichotomy, proarchodichotomy, opisthodichotomy, urodichotomy, amphidichotomy, and holodichotomy. Here we report the first occurrence of craniodichotomy in the mangrove salt marsh snake, *Nerodia clarkii compressicauda* (Fig. 1).

This specimen was captive born on 10 June 2000 from wild-collected parents originating from Big Torch Key, Monroe County, Florida, USA. After birth, this snake moved slightly before suddenly dying, and upon further examination it had severe spinal deformities. This specimen was deposited in the Florida Museum of Natural History, University of Florida (UF 120890).



Fig. 1. Dicephalic mangrove salt marsh snake, *Nerodia clarkii compressicauda* (UF 120890).



Natricine snakes are reported to represent approximately 18% of axial bifurcation cases in snakes, yet this frequency of observation appears to be correlated with ease of observation rather than fecundity (Smith and Perez-Higareda, 1988). Since most duplex individuals die as neonates, species that are more common in the wild or popular in captivity are more likely to be observed after birth or hatching than less common species (Smith and Perez-Higareda, 1988). Nonetheless, duplicity in snakes is a rare phenomenon occurring in about one out of every 100,000 neonates (Belluomini et al., 1978).

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## A Replacement Name for Bell's Spiny Lizard, *Sceloporus belli*

Hobart M. Smith, David Chiszar and Julio A. Lemos-Espinal

In 1995 we described a new subspecies of *Sceloporus undulatus*, *S. u. belli*, honoring our colleague and long-time specialist in the taxonomy of the *undulatus* group of the genus, Dr. Edwin L. Bell. Later, Lemos-Espinal *et al.* (1998) elevated the taxon to the rank of species on the basis of sympatry at least in one locality with *S. u. consobrinus*. No contrary evidence is yet known.

With considerable chagrin we have learned through our honored colleague that his patronym is a junior secondary homonym of *Tropidolepis bellii* Gray (1831:44). *Tropidolepis* Cuvier (1829) is a junior synonym of *Sceloporus* Wiegmann (1828), hence Gray's name is now assigned to *Sceloporus* and is therefore a senior secondary homonym of *Sceloporus belli* Smith *et al.*

The description of *Tropidolepis bellii* Gray is too brief for identification of the taxon to which the name was applied: "*Bell's Tropidolepis. Trop. bellii* Gray. Metallic green scales of the back and upper part of the body, and tail long, strongly keeled, dagger pointed, the keels forming 14-16 ridges; of the belly broad, blunt, those of limbs and tail smaller, becoming larger near the end; length 10 inches. Mus. Bell."

This description probably applies to some member of the *formosus* group, but any of several species could be represented. No specimen number or locality was given. No light is shed on the matter in Gray (1845), where one would expect the name would be entered. It is not, and none of the 10 species of *Tropidolepis* dealt with there are credited to the Bell Museum. The 1845 descriptions are briefer than the 1831 description, and differently composed, so that no similarity in that respect leads to a possible allocation of *T. bellii*. The name has to remain at least for the present, and probably for all time, in limbo, as a *nomen dubium*.

Regardless of identity, *T. bellii* Gray remains a senior secondary homonym of *S. belli* Smith *et al.* So far as we are aware, Gray's name has never been used since it was proposed; it is cited in none of Boulenger's catalogs of the lizards of the British Museum (1885, 1887), or in his monograph of *Sceloporus* (1897), and of course it was not known to Smith (1939). *S. belli* Smith *et al.* cannot automatically be regarded as a *nomen protectum* under the 1999 Code of Zoological Nomenclature (Art. 23.9), despite the antiquity and solely

original use of Gray's name, because the former has not been in use at least 10 years.

In the interest of nomenclatural stability, the International Commission on Zoological Nomenclature could be petitioned for preservation of *S. belli* Smith *et al.*, except that there is so little stability involved. The name is known and used almost exclusively by taxonomists; there is no extensive popular usage. Therefore we prefer to let the Principle of Priority reign, requiring the replacement of *S. belli* Smith *et al.* We here propose the substitute name, *Sceloporus edbelli* *nom. nov.*, for the unavailable name *Sceloporus belli* Smith *et al.*

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## Book Review

*Amphibians of Central and Southern Africa*, by Alan Channing, 2001. Cornell University Press, Sage House, 512 E. State Street, Ithaca, NY. ISBN 0-8014-3865-9, Cloth \$49.95.

The *Amphibians of Central and Southern Africa* provides the first comprehensive guide to the frogs, toads, and caecilians of the southern third of Africa, which includes Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, South Africa, Zambia, and Zimbabwe, written by the world's most well-known authority on the Anuran fauna of Central and Southern Africa.

The Introduction provides a synthesized review of the natural history of the amphibians in countries forming the southern third of Africa. Each species is described with information on local and current common names, along with the scientific name, and specific epithet for each species. A brief description, followed by remarks on distribution and habitat, advertisement call, breeding tadpoles, in addition to key references on the 205 species of frogs and toads (along with 2 species of caecilians) covered in detail within the text. Of these, 173 species are illustrated in color in 24 plates within the text. The illustrations of the tadpoles are superb and make this book an exceptional edition, while the distributional maps are small and of little significance, giving only an approximation of the range for each species covered within the text. One species of *Hemiscus* and one species of *Amnirana* are new to science, and are being described in details elsewhere. Other aspects covered within the Introduction include a brief history of amphibian studies in Central and Southern Africa stemming from Linnaeus in 1758, a listing of the major natural history museums in Africa along with addresses which would prove time saving for those researchers interested in contacting collection managers, and comments on collecting.

The author stresses the awareness of declining populations of anurans throughout the world, which has been attributed to human activities in the majority of the cases. A list of The World Conservation Union (IUCN) Red Date Book species from a workshop held in Cape Town in 2000, is provided which cites some 37 species found with southern Africa is provided.

Keys are provided for the nine families of Anurans, along with keys for species from each family within the species accounts, which cover 356 pages

*News and Notes*

within the text. This is followed by a short section on fossil frogs, with *Thoraciliacus* an illustration from a crater lake in Namaqualand being illustrated, and a 38 page well illustrated section on the identification and terminology of tadpoles for those known species found in southern Africa. A 28 page bibliography, and systematic and alphabetical index, which is current up through 1999, round out this impressive volume.

This excellent book should be on the shelf of anyone having an interest in central and southern African anuran fauna, as it is a comprehensive treatment of extraordinary importance, and as in former monographs by the author they are extremely accurate in details, and filled with expertise.

The moderate cost of this cloth bound volume should warrant anyone having an interest in anuran biology, and herpetology, and especially those interested in showing any inclination towards Southern Africa in general should certainly purchase a copy for their library.

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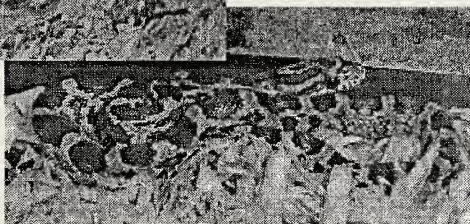


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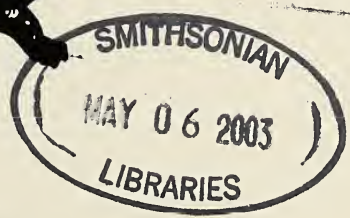
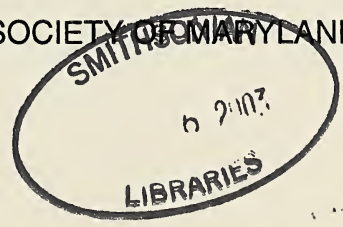
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DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



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## COLONIZATION OF HERPETOFAUNA TO A CREATED WETLAND

*T'Shaka A. Touré<sup>1</sup> and George A. Middendorf<sup>2</sup>*

### Abstract

The colonization by amphibians and reptiles of a newly created wetland was investigated at a site along Sands Road in Davidsonville, Anne Arundel County, MD. This 52-hectare artificial wetland was constructed in a gradient design that resulted in four distinct terraced sites that temporarily retain rainwater (Fig. 1). This palustrine wetland site, surrounded by an emergent, young, shrub-scrub, forested area, is characterized by the appearance of shallow temporarily flooded areas over a clay substrate that remains wet even during the driest periods of the year with a groundwater depth less than 1.5 m. The adjacent natural forest bordering the Patuxent River served as a natural indicator of amphibian and reptile activity and a source for site colonization. The created wetland site was monitored over two field seasons (March through September 1995-96) using linear transects, frog calls, drift fence arrays, pitfall and funnel traps, and dipnets. Sampling, conducted for 54 days revealed a total of twenty-eight species (16 amphibians and 12 reptiles). The colonization of this created wetland compared favorably in diversity to adjacent, natural forest. Factors best explaining differences in herpetofaunal activity, across the different sites within the created wetland, were density of vegetation surrounding the waterbody and hydroperiod.

### Introduction

Amphibians and reptiles remain abundant in the deciduous forests of the eastern United States despite their worldwide decline due to habitat destruction, introduced predators and competitors, pesticide pollution, acid precipitation, and global climate change (Wake and Morowitz 1990; Wake 1991). Previous regional herpetofaunal surveys for Maryland and the District of Columbia region provide ample historic documentation of amphibian and reptile distribution within the DC metro region (Kelly *et al.* 1936; McCauley 1945, 1949; Mansueti 1949; Stine 1953a, 1953b, Cooper 1960; Harris 1966, 1969, 1975; Conant and Collins 1998). The 63 herpetofaunal species known for this region include 29 amphibians (14 salamanders and 15 frogs; Table 3) and 34 reptiles (6 lizards, 10 turtles, and 18 snakes; Table 4). Because many species found regionally are restricted to very particular and often lo-

calized conditions that are not evenly distributed (Conant and Collins 1998; Harris 1975), local diversity is often lower than regional diversity. In the nearby 200 ha Jug Bay Wetland Sanctuary (Lothian, Anne Arundel County, MD), Smithberger and Swarth (1993) documented 39 species of amphibians and reptiles in a six-year study.

In recent years, wetland creation has been frequently employed as a mitigation technique to offset natural wetland losses, particularly for losses from highway construction and other commercial and private development (Johnston 1994). A vegetative study conducted at the Sands Road site located in Anne Arundel County, MD (Perry *et al.* 1997) indicated that this mitigation effort provided many of the ecosystem functions of a natural forested wetland and suggested that, like a number of other studies (Johnston 1994; Semlitch and Brodie 1998; Semlitch 2000a, 2000b), created wetlands may be an effective way to deal with increasing developmental pressures. Yet, few examinations have been made to determine whether these constructed sites actually reproduce conditions that create functional habits for wildlife populations (Leschisin *et al.* 1992).

### Methods

Sites - The created wetland was constructed as a series of terraces that allowed water flow from the highest terrace (Site D) across three earthen levees until finally discharging through the natural forest (NF) and into the Patuxent River. Each terrace differed slightly with respect to gradient (but averaged approximately 1.5 m drop per 100 m), in distance from the probable colonization source, and in emergent vegetation (Table 1; Fig. 1). To allow comparison of species activity and colonization patterns, study sites were located in each of the four terrace levels and in the adjacent natural forest (NF) adjacent to the river.

Presence - Species' presence was determined following standardized protocols (Heyer *et al.* 1994) that involved utilization of transects, drift fences, funnel and pitfall traps, dipnets and frog call surveys to maximize the probability of documenting species colonization and activity in the study area.

Linear transects - Diurnal visual surveys along 100-m linear [diagonal across site NE-SW direction] transects were conducted at a minimum of 4 times per month within each site. Vernal pools and microhabitats were sampled along the transect path (Scott 1994).





Figure 1. Sands Road Wetland Sanctuary, Anne Arundel County, Maryland

Drift fences – Drift fence arrays, located on berms bordering each terrace, allowed monitoring of movement. Drift fences (30 m) were constructed of aluminum flashing (Bury and Corn 1987; Corn 1994; Dodd and Scott 1994; Greenberg *et al.* 1994).

Pitfall traps – Twelve pitfall traps (5-gallon plastic white bucket), six on each side of the drift fence were set up in each site. There were 60 pitfall traps constructed for the overall study.

Funnel traps – Two double-ended funnel traps, one on each side of the drift fence, were established within each site in order to capture snakes (Fitch 1951; Clark 1966; Richter 1995).

**Frog call surveys** – Call surveys were conducted by recording anuran choruses for a minimum of two days per month. Surveys were taken primarily during nocturnal periods, although diurnal calls were recorded (Rand and Drewry 1994).

**Dipnets** – The capture of aquatic tadpoles and the observation of salamander larvae during the day were enhanced by the use of this technique. The use of dipnets allowed amphibians to be captured in waters with thick vegetation or debris (Wright and Wright 1949; Crisafulli 1997).

Each individual captured or seen was identified, and whenever possible, sexed and measured (snout to vent [SVL] to the nearest mm). Species identification was confirmed by using Green and Pauley (1987), Conant and Collins (1998) or through consultation with the curators and staff of the Smithsonian Institution's Division of Amphibians and Reptiles. For each individual, date, time, location within the site, vegetation in the immediate area, presence or absence of standing water, turbidity, air and water temperatures, other weather conditions, as well as any other unusual features were recorded (Heyer *et al.* 1994; McDiarmid 1994). Voucher specimens for each species were collected for each site. Following standard practice (Pisani 1977), most amphibian voucher specimens were immersed in a solution of chlorotone, while tadpoles were transferred directly to formalin. Other specimens were chilled, frozen, and thawed immediately after expiration. All specimens were tagged with USNM field tags, preserved in formalin (40% formaldehyde), and then transferred to ethyl alcohol (70%) (Pisani 1977), and deposited in the Smithsonian Institution, National Museum of Natural History, Division of Amphibians and Reptiles collection (USNM).

Table 1. Distance between natural forest (NF) and created wetland (A-D) sites.

Site	Distance from colonization source	Gradient
NF	0	1.5 meters
A	228	1.5 meters
B	321	1.5 meters
C	361	1.5 meters
D	373	1.5 meters

Table 2. Amphibian and reptile species richness, diversity index (Simpson's and shannon-Weiner),  $H_{max}$ , and equitability by site.

AMPHIBIANS

	Species Richness	Simpson's	Shannon-Weiner	Hmax	Equitability	Total Captures
Natural Forest	16	0.83	2.95	3.91	0.75	443
Site A	14	0.71	2.25	3.7	0.61	580
Site B	13	0.77	2.3	3.58	0.64	287
Site C	12	0.65	1.74	3.46	0.5	357
Site D	13	0.83	2.71	3.58	0.75	176
Average of wetland sites	13	0.74	2.25	3.58	0.625	350
Standard deviation of wetland sites	0.816497	0.07746	0.397576	0.09798	0.102794	170.4836
Degrees of freedom=3						
Prob.>1	*0.034897	0.329316	0.176517	*0.043474	0.310932	0.623349

REPTILES

	Species Richness	Simpson's	Shannon-Weiner	Hmax	Equitability	Total Captures
Natural Forest	4	0.72	1.92	2	0.96	5
Site A	6	0.79	2.42	2.58	0.94	9
Site B	6	0.54	1.64	2.58	0.64	26
Site C	2	0.22	0.54	1	0.54	8
Site D	6	0.64	1.94	2.58	0.75	20
Average of wetland sites	5	0.5475	1.635	2.185	0.7175	15.75
Standard deviation of wetland sites	2	0.07746	0.797559	0.79	0.171343	8.732125
Degrees of freedom=3						
Prob.>1	0.651448	0.526292	0.744497	0.829919	0.25193	0.306003



Activity Patterns – To determine seasonal activity patterns each site was sampled a minimum of 4 days per month between March and September (Scott 1982; Mitchell *et al.* 1993; Scott 1994; Scott and Woodward 1994) for a total of 54 days (26 in 1995 and 28 in 1996).

Residency – Amphibian breeding site and habitats in the natural forest and the constructed wetland sites were monitored to establish whether a given species' presence was temporary or permanent, i.e. whether the species was represented by colonizing individuals or by individuals representing a fully reproductive and self-sustaining population (Campbell and Christman 1982).

Analysis – Means, standard deviations, Simpson's and Shannon-Weiner Diversity Indices,  $H_{\max}$ , an Equitability Index, and basic statistics were calculated in Microsoft Excel 97 to examine site variation, including diversity (Krebs 1989; Stiling 1992; Hayek 1994). An *a priori* significance probability level of 0.05 was used for all statistical comparisons.

## Results

In total, twenty-eight species of amphibians and reptiles were documented in the created wetland at the Sands Road Wetland Sanctuary. These observations include almost half of the species (63) known for the Washington, DC Metro region (Conant and Collins 1998).

While many amphibian species were found in all sites (Table 2), reptile species were neither widespread nor abundant (Table 4). This is somewhat expected because amphibians are more suited for wetland environments which this was. Particularly widespread (at all sites) and abundant (10 or more observations) amphibians included American toad (*Bufo americanus*), green frog (*Rana clamitans*), and southern leopard frog (*R. sphenoccephala utricularia*). Species found at all sites — but with fewer than 10 observations in some sites — included cricket frog (*Acris crepitans*), Fowler's toad (*B. fowleri*), pickerel frog (*R. palustris*), spadefoot toad (*Scaphiopus holbrookii*), marbled salamander (*Ambystoma opacum*), and northern slimy salamander (*Plethodon glutinosus*) (Table 3). While no single species of reptile was found in all sites, painted turtle (*Chrysemys picta*) and eastern mud turtle (*Kinosternon subrubrum*) were encountered in four of the five sites (Table 4).

While all amphibians observed in the created wetland were documented in the natural forest, only 4 of the 12 expected reptiles were recorded (Tables 3 and 4). The natural forest with its vernal pools and adequate vegetative

Table 3. Number of amphibians captures or observed along the Patuxent River in the natural forest and four adjacent created wetland sites (1995/1996).

AMPHIBIANS

	Natural Forest	Site A	Site B	Site C	Site D	Wetland Average	Wetland std	P>t
<b>Hyliidae</b>								
<i>Acris crepitans</i>	12/0	10/2	27/8	0/2	9/0	14.5	14.29452	0.872301
<i>Hyla chrysoscelis</i>	1/7	0/0	0/0	0/2	1/0	0.75	0.957427	*0.004777
<i>Hyla cinerea</i>	0/3	0/2	0/0	0/2	0/0	1	1.154701	0.181690
<i>Pseudacris crucifer</i>	3/0	7/0	7/0	0/0	5/0	4.75	3.304038	0.633044
<i>Pseudacris triseriata</i>	P	P	P	P	P	-	-	-
<b>Bufonidae</b>								
<i>Bufo americanus</i>	76/54	56/225	21/23	34/18	19/7	100.75	120.6576	0.824081
<i>Bufo fowleri</i>	5/2	0/83	0/10	3/63	0/10	42/25	37/88029	0.432556
<b>Ranidae</b>								
<i>Rana catesbeiana</i>	5/0	1/0	3/2	0/0	0/8	3/5	2/696846	0.712130
<i>Rana clamitans</i>	61/2	24/9	18/20	18/5	10/6	27.5	9.882645	*0.036966
<i>Rana palustris</i>	2/3	3/2	5/2	1/1	8/0	5.5	2.645751	0.86216
<i>Rana sphenoccephala</i>	57/24	15/82	33/85	6/101	8/43	93.25	29.44345	0.705343
<b>Pelobatidae</b>								
<i>Scaphiopus holbrookii</i>	0/57	0/28	1/2	0/77	2/35	36.25	30.7395	0.548027
<b>Ambystomatidae</b>								
<i>Ambystoma opacum</i>	43/2	17/6	3/7	18/4	3/1	14.75	9.287088	*0.047231
<i>Ambystoma maculatum</i>	0/1	0/0	0/0	0/0	0/0	0	0	-
<b>Plethodontidae</b>								
<i>Plethodon glutinosus</i>	0/19	0/6	0/7	0/2	0/1	4	2.94392	*0.014615
<b>Salamandridae</b>								
<i>Notophthalmus viridescens</i>	3/0	1/1	2/1	0/0	0/0	1.25	1.5	0.327652

P= species identified as present based on calling observations, but individuals were neither seen nor captured.



coverage provided particularly good habitat for amphibians and thus, probably served as the "source" site for amphibian colonization of the created wetland sites. Abundant species in the Natural Forest Site, e.g. American toad, green frog, southern leopard frog, spadefoot toad, marbled salamander, and northern slimy salamander, were also seen in all four created wetland sites. We note that the only spotted salamander (*Ambystoma maculatum*) captured during the two-year study was found only in the natural forest.

In Site A, which at 228 m was the closest created wetland site to the natural forest, we found 14 species of amphibians and 6 species of reptiles (Tables 3 and 4). With an abundance of amphibian species—only 2 from the natural forest site were absent — this site exhibited high amphibian richness and diversity (Table 1). In fact, the capture rate for amphibians in this site was greater than that for all other sites — including the natural forest. Three species, American toad, Fowler's toad, and southern leopard frog, were especially abundant. The numbers of reptile species were similarly high and are mirrored in both high richness and diversity values (Table 1). These high faunal diversities probably resulted from the fact that species could easily move the short distance from the adjacent natural forest, the source of colonization, and that the site retained water throughout the spring season, making it attractive for both breeding and feeding.

Site B, located 321 m from the natural forest, revealed 13 amphibians and 6 reptiles (Tables 3 and 4). A small pond located in this site provided a source of water during dry periods and was a focus of much herpetofauna activity (Table 3). This pond and its environs served as refugia for a number of species, e.g. painted turtle laid eggs in adjacent sandy areas, green frog and bullfrog (*Rana catesbeiana*) tadpoles were observed in the waters, and during the early spring, a southern leopard frog was observed emerging from hibernacula. Because it retained water longer than others during the summer season and provided adequate vegetative coverage, activity on this site was high and overall diversity was similar to that for Site A (Tables 1 and 2).

Site C, was 361 meters from the natural forest, and only 12 amphibian species and 2 reptile species were observed (Tables 3 and 4), resulting in the lowest richness and diversity among all sites (Tables 1). None-the-less, Site C must have contained some features not abundant in other sites as more spadefoot toads were observed here than for the other sites (Table 3). It is possible that the presence of breeding congregations of spadefoot toads resulted after heavy rains and by habitat features associated with the proximity of an old sand quarry.



Site D, the furthest of the sites, at 373 m, from the natural forest with 13 amphibian species and 6 reptile species (Tables 3 and 4), displayed moderate richness and diversity for amphibians and high richness and diversity for reptiles (Table 1). Although documented in all study sites, pickerel frog, which uses a variety of aquatic habitats (including bogs, seeps, grassy meadows, and the margins and banks of marshes, swamps, brooks, and streams), was more common here than in other sites. The diversity here may be the result of a small patchy shrub-scrub area that provided shade for reptiles during the

Table 4. Number of reptiles captures or observed along the Patuxent River in the natural forest and four adjacent created wetland sites (1995/1996).

REPTILES					
	Natural Forest	Site A	Site B	Site C	Site D
<b>Colubridae</b>					
<i>Carphophis amoenus</i>	0/0	2/1	0/0	0/0	1/2
<i>Nerodia sipedon</i>	0/0	0/0	1/0	0/0	0/0
<i>Virginia valeriae</i>	0/0	2/0	0/0	0/0	0/0
<i>Thamnophis sirtalis</i>	0/0	1/0	1/0	0/0	1/0
<i>Heterodon platirhinos</i>	0/0	0/0	1/0	0/0	0/0
<b>Scincidae</b>					
<i>Eumeces fasciatus</i>	2/0	0/0	0/0	0/0	0/0
<b>Teiidae</b>					
<i>Cnemidophorus sexlineatus</i>	0/0	0/0	0/0	0/0	1/0
<b>Chelydridae</b>					
<i>Chelydra serpentina</i>	1/0	0/0	1/1	0/1	0/1
<i>Chrysemys picta</i>	0/0	0/1	14/6	0/7	4/7
<b>Emydidae</b>					
<i>Terrepene carolina</i>	0/0	1/0	0/0	0/0	0/0
<b>Kinosternidae</b>					
<i>Kinosternon subrubrum</i>	1/0	0/1	1/3	0/0	2/1
<i>Sternotherus odoratus</i>	1/0	0/0	0/0	0/0	0/0

day and was used by anurans for calling at all hours of the day and evening. As in Site B, nests and egg hatchlings of painted turtles were found. Despite the presence of shade and water, the lower richness and diversity, compared to Site B, may be due to the distance from the colonizing source.

While it might generally appear that the number of species captured and the species richness for each site was correlated with the distance from the colonization source, specific trends are confounded by variation in vegetation and the duration of standing water. Species richness and diversity were significantly different among the sites (t-test;  $df = 3$ ;  $p = 0.03$ ). Species richness of assemblages ( $H_{max}$ ) was significantly more diverse in the natural forest than the created sites (t-test;  $df = 3$ ;  $p = 0.04$ ). For amphibians, Cope's gray tree frog (*Hyla chrysoscelis*), green frog, marbled salamander (*Ambystoma opacum*), and northern slimy salamander (*Plethodon glutinosus*) assemblages were significantly greater in the natural forest (t-test;  $df = 3$ ;  $p = 0.004, 0.03, 0.04, 0.01$ ). For reptiles, no significant differences were detected in richness or diversity between the natural forests and created wetland. During the two-year study average of total captures for reptiles (15.75) was much smaller than that seen for amphibians (350) (Table 2).

### Conclusions

The creation of wetlands as a mitigation tool is increasingly important as wetlands have been shown to play a major role in reducing the likelihood of local extinction (Gibbs 1993) and may offset local extinction effects due to wetland loss, as well as increasing levels of fragmentation (Gibbs 1998). Examination and determination of critical features associated with successful mitigation via wetland creation is, thus, of great usefulness.

We note that one of the major goals in using created wetlands for mitigation purposes is the establishment of successfully reproducing populations. It is not enough that species migrate to and occupy a created site, they must also successfully reproduce. Herpetofaunal activity occurs within a variety of habitats and microhabitats that provide features essential for foraging, predator escape, thermoregulation, and reproduction. Successful reproduction may require features quite different than those associated with foraging, escape and thermoregulation, particularly for those species dependent upon vernal pools, ponds, and vegetative coverage. For instance, created wetlands that retain water in the spring but not into and through the summer and fall, may provide features adequate for breeding but not, ultimately, for successful reproduction. Clearly, wetlands able to provide features critical for repro-



duction are better suited for colonization and successful establishment of amphibian and reptile populations.

With its greater habitat diversity, vegetative coverage, and biomass, the natural forest provided source populations of amphibians and reptiles to the newly created and previously unoccupied areas. The high levels of amphibian diversity within a year following site creation is testament to the nearby location of a colonization source, the ability of these organisms to move distances, and to the attractiveness of the created habitat, particularly for the amphibians. The lower diversity of reptiles in both the natural forest and created wetlands may simply be due to their generally more secretive nature coupled with the difficulties of detecting them in mature forests (Gibbons and Coker 1978; Bennett *et al.* 1980).

The created wetland at Sands Road appears to have great potential as a suitable habitat for amphibians. The presence of amphibians and reptiles in all sites suggests that all sites provided microhabitats essential for successful foraging and predator escape. However, the results of the present study suggest that amphibians responded most positively, e.g. bred successfully, in sites where the hydroperiod was longest and where vegetative cover present. Resident species and reproductive success was documented during the second field season in sites B and D, the sites exhibiting the highest levels of diversity. The longer hydroperiods in both sites provided adequate habitat and sufficient time for successful breeding and reproduction to occur. The observation and capture of large bullfrog tadpoles in site B indicates year-round presence of water as the species can take two years to metamorph. Although not documented as successfully reproducing, the emergence of a southern leopard frog from its winter hibernacula during the second field season is a positive indication of features associated with habitat necessary for permanent residency.

Physical habitat characteristics important to colonization should be expected to change over time, leading to differential colonization and occupation patterns. Examples include distance from the source, amount and depth of standing water, water turbidity, and vegetation. As these change, so too will the herpetofaunal community (Burke and Gibbons 1995; Thomas and Barron 1995; Mitchell 1996; Gibbons *et al.* 1997). The appearance of northern slimy salamanders in the second year in all five sites is suggestive of habitat change as it was not seen in any of the sites in the first year. Another salamander, spotted salamander, may be of particular interest in designing and



determining long-term habitat suitability of mitigated sites. Colonization by this salamander is constrained by particular habitat requirements such as mature forest, vernal pools and ponds and is probably not at all affected by an inability to travel long distances (Semlitch 1998).

A five-year survey at the nearby (8 km S of the Sands Road site), 200 ha Jug Bay Sanctuary (Smithberger and Swarth. 1993) revealed 39 species of amphibians and reptiles: 18 amphibians (11 anurans, 7 salamanders) and 21 reptiles (7 turtles, 3 lizards, 11 snakes). These numbers are only slightly greater than those documented during the two-year Sands Road study: 16 amphibians (12 anurans, 4 salamanders) and 12 reptiles (5 turtles, 2 lizards, 5 snakes). The higher richness in the Jug Bay Sanctuary is likely due to greater variation in habitat types that include freshwater tidal and non-tidal wetlands, upland hardwood forest and agricultural fields. The majority of amphibians and reptiles recorded at Jug Bay were found within both upland and non-tidal wetland areas, while all species recorded in Sands Road were in a palustrine habitat within a young forest.

By monitoring the seasonal activity and utilization of the created wetland, knowledge was gained on the essential factors to be considered when constructing suitable habitats for successful colonization and reproduction of amphibians, reptiles, and other wetland dependent species. Amphibians warn us about our environment and by studying their colonization to created habitats more information can be attained which may allow us to make intelligent recommendations on how to better preserve our natural environment and wildlife.

It will be interesting to observe changes in herpetofaunal diversity as the sites mature and the results of this study will provide baseline data for future studies within the Sands Road Wetland Sanctuary.

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# SPATIAL DISTRIBUTION IN A NEOTROPICAL LIZARD, *LIOLAEMUS QUILMES* (LIOLAEMIDAE): SITE FIDELITY AND OVERLAPPING AMONG MALES AND FEMALES

Monique Halloy and Cecilia Robles

## Abstract

We investigated spatial distributions, site fidelity, and overlap in a neotropical lizard, *Liolaemus quilmes*. We selected a site (60x60m) within its distribution in northwestern Argentina. Adults were captured, measured and marked, and released at the site of capture. We monitored marked individuals during three austral springs and summers. Both males and females showed site fidelity having similar spatial distributions one year to the next. Male activity areas were significantly larger than those of females and they overlapped with one to two females. Females also overlapped with one to two males. Finally, male activity areas overlapped considerably among themselves whereas those of females did not overlap among themselves.

Little is known about the ecology of lizard species belonging to the South American genus *Liolaemus* (Liolaemidae, Frost et al., 2001, recently elevated from its former status as a subfamily of the Tropiduridae, Frost and Etheridge, 1989). Spatial distribution is one aspect that can give insight into the intra- and intersexual interactions of a species and its relationship to reproductive strategies. By spatial distribution of a lizard, we considered the entire area in which an individual moved, i.e., its activity area or home range (Rose, 1982). Several studies on home range sizes in lizard species of North America are available (e.g., Tinkle et al., 1962; Ferner, 1974; Stamps, 1977; Fair and Henke, 1999; Sheldahl and Martins, 2000) but few have been undertaken on South American species. Ortiz (1981) reported home range sizes for some species belonging to the *Liolaemus nigromaculatus* group and Rocha (1999) gave home range sizes for *Liolaemus lutzae*. In this study, we investigate the spatial distributions, site fidelity and overlap in male and female *Liolaemus quilmes* during the austral spring and summer of three consecutive years at a location in northwestern Argentina.

*Liolaemus quilmes*, one of more than 160 species in this neotropical genus (Schulte et al., 2000), is a diurnal, mainly insectivorous, and oviparous species (Ramirez Pinilla, 1992). It belongs to the *darwinii* complex (Etheridge,



1993) and it occurs in northwestern Argentina (southern part of Salta province, northwestern part of Tucumán province, and northeastern part of Catamarca province). The species ranges from about 1600 m to just below 3000 m, occupying arid to semi-arid habitats. Males are slightly larger and more colorful than females (Etheridge, 1993).

Materials and Methods

Our study site was located at Los Cardones (2700m), Tucumán province, Argentina, well within the distribution of this species. The site is characterized by firm substrate, large rocks, shrubs and cacti. It corresponds to the semi-arid Prepuna phytogeographic region of Cabrera and Willink (1980). We measured a grid of 60x60m, subdividing it into 5x5m quadrats using outdoor paint to mark rocks with the corresponding coordinates.

The study took place during the austral spring and summer of 1999-2000 (November to March, referred to as the first period), 2000-2001 (September to April, second period), and 2001-2002 (October to March, third period). Almost all the lizards were captured and marked during the first two periods (first period: 25 males and 21 females; second period: 22 males and 13 females; third period: 1 male and 1 female). Upon capture, lizards were measured and weighed (Table 1). They were then marked with a unique combination of two colored beads attached at the base of the tail with a surgical steel monofilament strand (Fischer and Muth, 1989). All elements used as well as the area of insertion of the strand were disinfected with alcohol. Marked lizards were released at the site of capture. This procedure did not seem to

TABLE 1 – Means and standard deviations of snout-vent lengths (SVL), total lengths (TL), and weights (W) for male and female *Liolaemus quilmes* from Los Cardones, Tucumán province, Argentina.

	Males (n = 48)	Females (n = 35)
SVL (cm)	6.13 ± 0.48	5.72 ± 0.37
TL (cm)	14.32 ± 2.27	13.27 ± 1.80
W (g)	6.76 ± 1.62	5.66 ± 1.16

impair the lizards, since they were often found again in the same area soon after release as well as weeks and months later.

The site was visited two consecutive days per month during the first two periods and it was visited 12 days, end of October to the first week of November, and 5 days in March during the third period. During each visit, we searched for marked lizards at 10:00, 13:00 and 16:00 hours. We walked systematically, following the established coordinates, the starting point being selected randomly before each search. We used binoculars to identify lizards. When we sighted a lizard, we took note of its identity and its coordinates.

We used the program CALHOME (A Home Range Analysis Program, MS-DOS Version 1.0, 1994) which uses the minimum convex polygon method to calculate home ranges or activity areas. Following Rose (1982), regression analyses were made for males and females, separately, obtaining in each case that 9 sightings was the minimum number of sightings not correlated with area ( $F = 2.37$ ,  $df = 1, 51$ ,  $p > 0.05$ , one-tail;  $F = 0.47$ ,  $df = 1, 31$ ,  $p > 0.05$ , one tail, respectively). Of the total of 48 marked males, we obtained activity areas for 43 males (based on a minimum of 4 or more sightings), 21 of

TABLE 2 – Means ( $\bar{X}$ ) standard deviations (SD), and ranges of areas (in  $m^2$ ) occupied by male and female *Liolaemus quilmes* during different years at Los Cardones, Tucumán province, Argentina.

N: number of lizards for which we had a minimum of 9 or more sightings.

Period	Males			Females		
	N	$\bar{X} \pm SD$	Range	N	$\bar{X} \pm SD$	Range
November 1999 to March 2000	2	$77.0 \pm 46.0$	44.5 – 109.5	0	—	—
September 2000 to April 2001	6	$132.2 \pm 82.7$	22.5 – 242.5	2	$29.2 \pm 9.5$	22.5 – 36.0
October 2001 to March 2002	13	$182.5 \pm 109.4$	66.0 – 379.5	8	$21.9 \pm 12.6$	5.5 – 28.5



which had 9 or more sightings. Of the total of 35 marked females, we obtained activity areas for 30 females (based on a minimum of 4 or more sightings), 10 of which had 9 or more sightings. Although we considered lizards with fewer than 9 sightings to show the location of the various lizards in the grid (see results), in the data analyses, we used only the individuals for which we had a minimum of 9 or more sightings. For example, we compared areas of different periods only if we had a minimum of 3 individuals with 9 or more sightings. We used the Wilcoxon-Mann-Whitney test (Siegel and Castellan, 1988).

### Results

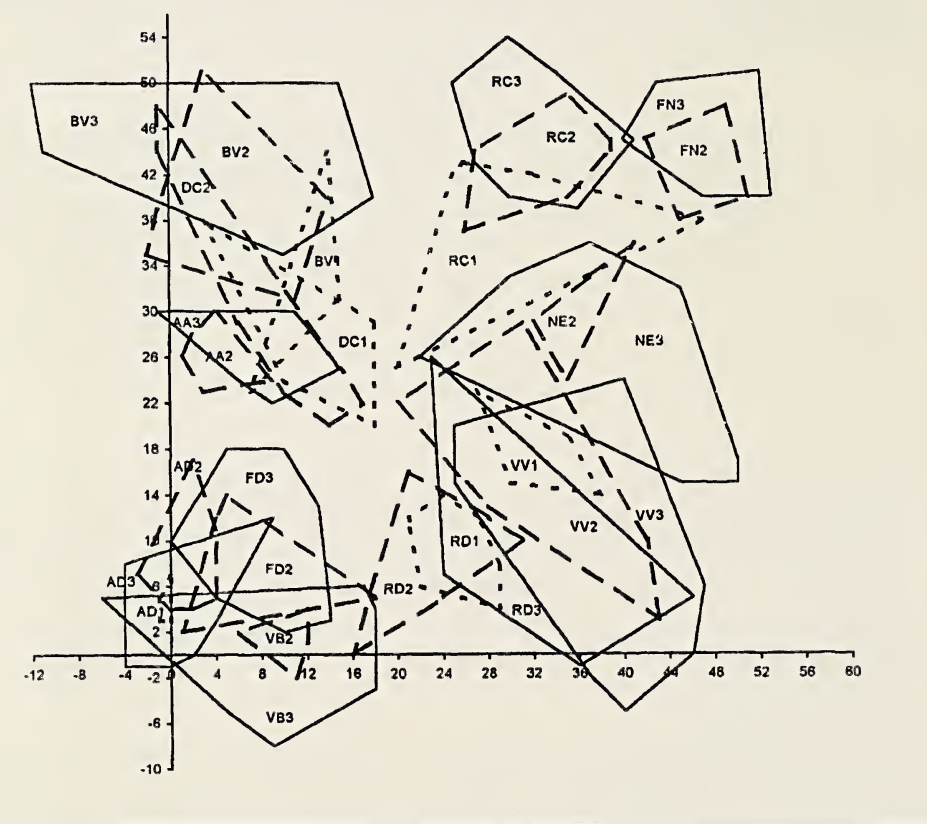
Activity areas varied across periods particularly for males (Table 2). Nevertheless, areas for males of the second and third periods were not significantly different ( $z = -0.88$ ,  $p = 0.38$ , two-tailed, Wilcoxon-Mann-Whitney test). On the other hand, areas for males were significantly larger than those of females during the third period ( $z = -3.8$ ,  $p < 0.001$ , two-tailed, Wilcoxon-Mann-Whitney test, Siegel and Castellan, 1988). Areas of males were on average 4.5 times larger than those of females during the second period and on average 8.3 times larger during the third period (Table 2).

Males as well as females were found to remain in a similar area across the three periods of study (Figs. 1 and 2, respectively). Although we did not always have a minimum of 9 sightings per lizard per period of study, the area they occupied year after year still reveals permanence in a certain space. This can be seen for 11 males, five of them during three consecutive years and the rest during two consecutive years (Fig. 1). In females, six were found in consecutive years occupying similar locations, two of them during three consecutive years (Fig. 2).

Male activity areas overlapped among themselves considerably during the second and third period (Figs. 3 and 4, respectively). For the first period, we had fewer marked males and consequently there was less overlap. Therefore, a graphic representation is not provided here. Because we did not have many males with a minimum of nine or more sightings, we did not calculate overlap percentage since activity areas or home ranges based on fewer than nine sightings are probably underestimated (Rose, 1982). Female activity areas, on the other hand, did not overlap among themselves in none of the three periods of study although they occasionally came in contact (Figs 3 and 4, second and third period, respectively). There was one exception: two



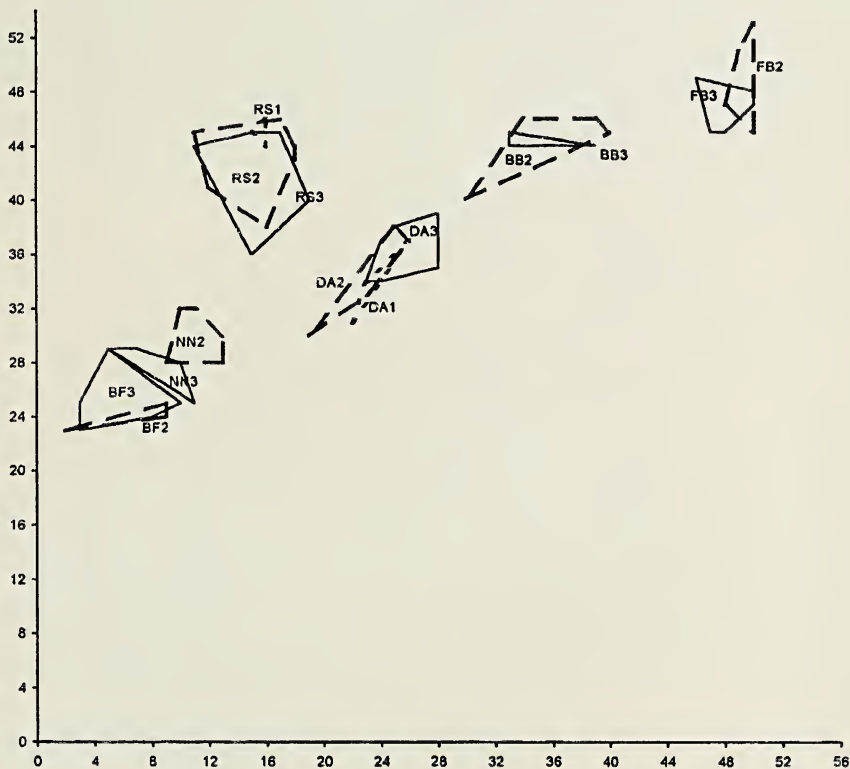
FIGURE 1. – Site fidelity in male *Liolaemus quilmes* during three consecutive periods (described in Methods). Individual males are identified by two-letter codes and a number that corresponds to one of the three periods of the study. The first period is noted by small dashed lines, the second period by larger dashed lines and the third by full lines. Activity areas are based on a minimum of 4 or more sightings and were calculated with the minimum convex polygon method. Axes are in meters.



females overlapped within the activity area of male FN during the third period (Fig. 4).

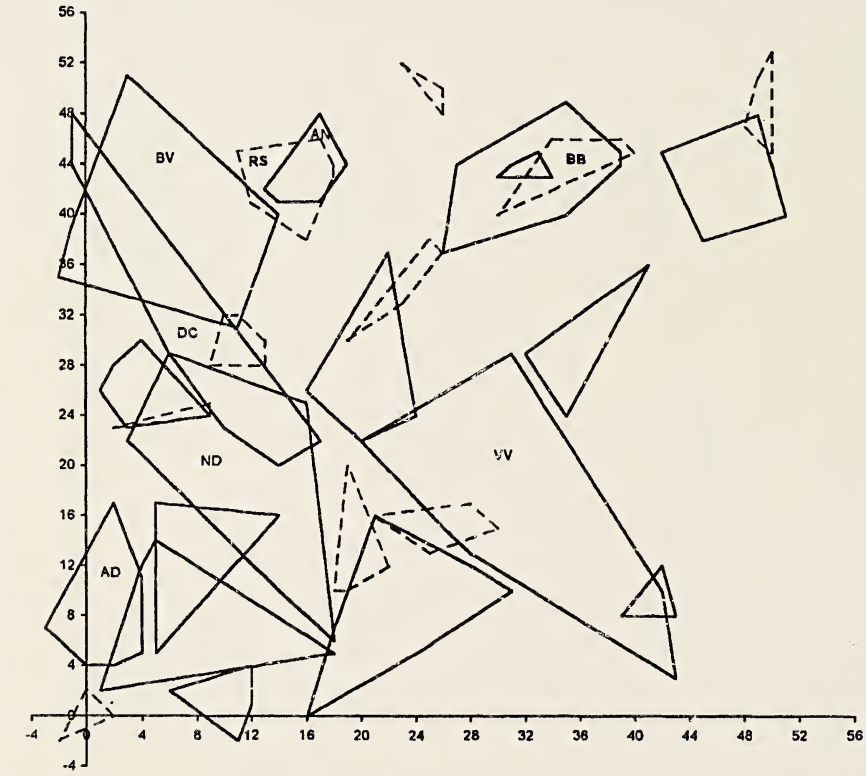
During the second period, of 17 males, 10 were found to overlap with one female, 1 with 2 females, and 6 did not overlap with any female. Of the 10 females for that same period, 4 had activity areas overlapping with one male, 4 with 2 males, and two did not overlap with any male (Fig. 3).

FIGURE 2. – Site fidelity in female *Liolaemus quilmes* during three consecutive periods (described in Methods). Individual females are identified by two-letter codes and a number that corresponds to one of the three periods of the study. The first period is noted by small dashed lines, the second period by larger dashed lines and the third by full lines. Activity areas are based on a minimum of 4 or more sightings and were calculated with the minimum convex polygon method. Axes are in meters.



During the third period, of 17 males, 8 had activity areas overlapping that of one female, 5 overlapped with 2 females, 1 overlapped with 3 females, 2 came in contact with a female activity area, and one did not overlap any female activity area. Of the 15 females, 6 had activity areas overlapping that of one male, 7 that of 2 males, 1 that of 3 males, and one came in contact with a male activity area (Fig. 4).

FIGURE 3. – Activity areas of male (full line) and female (dashed line) *Liolaemus quilmes*, during the second period of observation (spring and summer of 2000-2001). Activity areas are based on a minimum of 4 or more sightings and were calculated with the minimum convex polygon method. Individuals with 9 or more sightings are identified by two-letter codes. Axes are in meters.



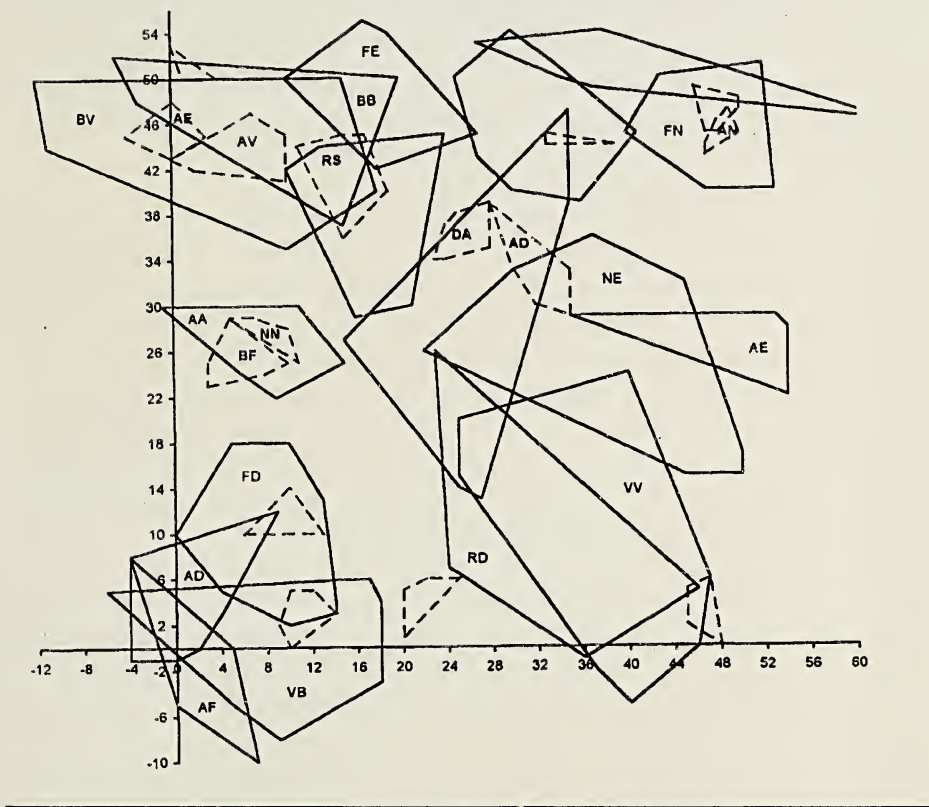
### Discussion

Activity areas of male *Liolaemus quilmes* were significantly larger than those of females. Our results are similar to those obtained for other iguanian species in that males tend to have larger home ranges than females, e.g., *Uta stansburiana stejnegeri* (Tinkle et al., 1962), *Liolaemus kuhlmani* (Ortiz, 1981), *Tropidurus torquatus* (Giaretta, 1996), *Sceloporus virgatus* (Abell, 1999).

Both males and females remained in the same area throughout their active season, some of them being sighted during the three periods of the



FIGURE 4. – Activity areas of male (full line) and female (dashed line) *Liolaemus quilmes*, during the third period of observation (spring and summer of 2001-2002). Activity areas are based on a minimum of 4 or more sightings and were calculated with the minimum convex polygon method. Individuals with 9 or more sightings are identified by two-letter codes (two-letter codes written in bold correspond to females). Axes are in meters.



study. This site fidelity has been observed in other similar sized iguanian lizards, e.g., *Sceloporus undulatus erythrocheilus* (Ferner, 1974); *Uta palmeri* (Hews, 1993); *Sceloporus occidentalis* (Sheldahl and Martins, 2000).

Male activity areas overlapped considerably during the second and third period of the study. Sheldahl and Martins (2000) recorded an overlap of 41.5% in *Sceloporus occidentalis*, and Ferner (1974) of 52% in *Sceloporus undulatus erythrocheilus*. However, other authors have found that, for similar sized iguanians (e.g., *Uta stansburiana stejnegeri*, Tinkle et al., 1962; *Uta palmeri*, Hews,

1993; *Liolaemus lutzae*, Rocha, 1999), home ranges in males overlapped little or not at all, possibly indicating territoriality (Tinkle et al., 1962; Stamps, 1977; Rocha, 1999). Other species of *Liolaemus* belonging to the *nigromaculatus* group have been characterized as either territorial, hierarchical or neither (Ortiz, 1981). In *L. quilmes*, males were seen patrolling their activity areas by standing on rocks, visually scanning the surroundings, legs outstretched and head bobbing. Visual displays (such as head bobs, lateral presentation, inflation of the body) were directed at approaching males, occasionally resulting in chasing and fighting (some of these behavioral patterns have been described for this species in Halloy, 1996, and for other iguanian species in Carpenter and Ferguson, 1977). This suggests a hierarchical rather than a territorial system in this species.

In her review of territorial lizard species, Stamps (1983) found that female home ranges either do not overlap among themselves or do so very little. In our study, female home ranges or activity areas did not overlap (except in one case, during the third period). When kept in an outdoor, 4x5m enclosure, females of this species were found to chase and fight any other female close by (Halloy, 1996). These traits (small non-overlapping activity areas and agonistic behavior among females when at close range) suggest territoriality in these females (as has been shown in many other iguanian species, Stamps, 1983; but see Hews, 1993, who observed considerable overlap and lack of territoriality in female *Uta palmeri*).

Male activity areas overlapped those of one to two females. Females as well, overlapped with one to two males. This is similar to what Rose (1982) and Abell (1999) found in *Sceloporus virgatus* in which males overlapped with two or more females and females with about two males suggesting a polygynandrous mating system. Although we need more observations, especially behavioral, *L. quilmes* may perhaps be seasonally monogamous (same male-female pairs were often seen basking on the same rock) as has been reported in *Liolaemus copiapensis* (Ortiz, 1981) and in *Uta stansburiana* (Tinkle et al. 1962; Fox, 1983; Stamps, 1983), or polygynandrous as in *Sceloporus virgatus* (Rose, 1982; Abell, 1999).

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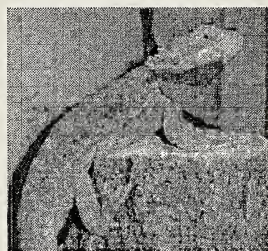
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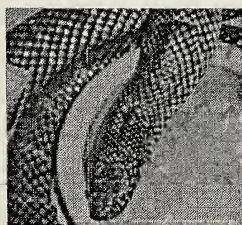


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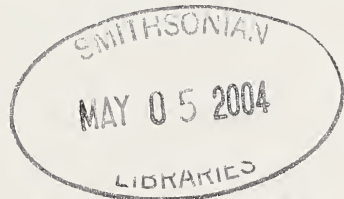
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# BULLETIN OF THE

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## Range Extensions and Variational Notes on Some Amphibians and Reptiles of Jalisco and Michoacán, México

Paulino Ponce-Campos, Sara M. Huerta-Ortega, Alan Heinze-Yothers and Hobart  
M. Smith

### Abstract

Herpetological studies in four areas of central western Mexico (the Barranca of the Río Santiago, central Jalisco; Guadalajara city, central Jalisco; Sierra de Quila, central Jalisco; and Sierra de Coalcomán, northwestern Michoacán) have produced extensions of ranges of *Eleutherodactylus pallidus*, *Eumeces dugesii*, *Boa constrictor imperator*, *Leptodeira bressoni*, *Ramphotyphlops braminus*, *Salvadora mexicana* and *Storeria storerioides*. Variational data on these taxa and *Enulius oligostichus* are presented.

### Introduction

Long-term, on-going studies have been conducted by PP-C and his associates on the herpetofauna of Jalisco and part of neighboring states, especially on western slopes.

Four areas have been of special interest, as follows. Of greatest geographic importance is the is the Barranca of the Río Santiago, a corridor for the passage of coastal, low-altitude species eastward toward the plateau, and of plateau species westward toward the coast. The Barranca has not been well collected, hence its full biogeographic importance remains to be realized. Preliminary efforts were reported by Ponce-Campos (submitted), Ponce-Campos and Heurta Ortega (1998 and in prerp.) and Ponce-Campos et al. (2001). We here report range extensions in this area for *Eleutherodactylus pallidus*, *Boa constrictor imperator* and *Salvadora mexicana*.

The herpetology of the Guadalajara area has been studied sporadically by numerous authors, among whom Dugès is perhaps the earliest, but never synoptically for that particular area. Perhaps the nearest is in Dugès (1889), comparing the herpetofauna (and other faunae) of Guadalajara with that of Guanajuato. The scattered records existing at the time were included among those for Mexico as a whole as early as Cope (1887) and Dugès 1896), and as recently as the checklists by Smith and Taylor (1945, 1948, 1950). Zweifel (1959) examined some questionable early records for the area.

The isolated Sierra de Coalcomán is still poorly known despite its proven endemism (e.g., *Barisia jonesi* Guillelte and Smith, 1982 (given specific rank in Smith *et al.* 2002); *Coniophanes sarae* (Ponce-Campos and Smith, 2001; *Sceloporus insignis* Webb, 1967; *Geophis pyburni* Campbell and Murphy, 1977, and others). We here report a range extension of *Storeria storerioides* in that area.

The Sierra de Quila of central Jalisco has also been collected little in the past. We here report *Eumeces dugesii* from there.

Additionally, we here describe the variation in a recently collected specimen of *Enulius oligostichus*.

Specimens cited are in the collection of Bosque Tropical A.C., Guadalajara, Jalisco (BTM), and in the Museum of the Universidad Autónoma de Guadalajara (UAGM).

### Species Accounts

*Eleutherodactylus pallidus* (Duellman) (Pale Chirping Frog). Found in an area of subtropical scrub forest, by Alan Heinze-Yothers and Paulino Ponce-Campos June 8, 2000 at 705 m, 20° 56' N, 103° 37' W, specimen BTM-007. The locality is a range extension 107 km southeast from 30 mi southeast of Tepic, Nayarit (Davis and Dixon, 1957) and 130 km east, from 18.8 mi NW Ahuacatlán, Nayarit (Lynch, 1970). PP-C found the species at Puerto Vallarta, on the coast of Jalisco. Two specimens are larger than others recorded of the species. Lynch (1970) recorded the maximum size as 19.3mm. Our specimen is 22.2mm in SVL and weighed 0.8g. Another specimen taken in the same area 27 June 2000 and released *in situ* measured 20.6mm in SVL, weight 0.6g. Both specimens were calling males.

*Eumeces dugesii* Thominot (Dugès's Skink). Four examples were measured and photographed (BTM008) in the field and released in the area of Sierra de Quila, Jalisco, 2,078 m (20° 18' N & 104° 04' W) by PP-C, Rodolfo and Hector Romero-Contreras and M. en C. Rodolfo Romero-Luna. They were found in oak and pine forest between 2,078-2,228m altitude. Three localities are recorded for the species in Jalisco: 3 mi WSW Mazamitla, Nevado de Colima and Ajijic in Chapala Lake (Peterson *et al.*, 1995). Our records are 88 km WNW from Ajijic, heretofore the northernmost record.

*Boa constrictor imperator* Duadin (Mexican Boa Constrictor). One specimen (BTM002) was obtained by a local resident, Pedro Esparza Gonzáles, from the municipality of Zapopán near Guadalajara, 1074 m (20° 47' N, 103° 19' W). It was



found in an area of disturbed subtropical scrub forest during early August 2001. This extends its known range from the lowland coasts over all of Jalisco (García and Ceballos, 1994).

*Enulius oligostichus* Smith, Arndt and Sherbrooke (Mexican Longtailed Snake). A specimen of this species will be reported for the first time in Jalisco by Ponce-Campos (submitted). It was found in disturbed subtropical scrub forest at an altitude of 1189m (BTM-003). Other records are from lowlands, even near sea level (Smith *et al.*, 1967; McDiarmid and Bezy, 1971). It is smaller than others reported, at 116mm. The tail is incomplete, at 25mm.

Due to the rarity of the species, the variation exhibited by this specimen is of special interest. It differs from previous descriptions in having a higher ventral count (166) (subcaudals 47, tail incomplete); anterior and posterior temporals fused on the left side (separate on right); supraocular fused with parietal on the right side (separate on left).

As in other specimens, the dorsal scales are smooth, with a single apical pit; five supralabials; six infralabials; nasal fully divided; scale rows 15-15-13, the latter count at the vent. The size and arrangement of the anterior and posterior chinshields, the shape and size of the maxillary teeth, and the position of the anterior tip of maxilla between first and second supralabials, are as in the original description (Smith *et al.*, 1967).

In life the head is brown, a little darker than the dorsum of the body (gray-brown); latter color lighter on sides; venter light gray.

*Leptodeira bressoni* Taylor (Bresson's Splendid Cat-eyed Snake). A specimen (BTM-004) was found near Guadalajara in the Barranca del Río Santiago at 1080m (20° 46' N, 103° 19' W), 5 March 2002 by a local resident, Rogelio Contreras Esparza. Also four specimens were found in the canyon by PP-C, AH-Y and Carlos Morfín (data recorded in the field and released, 21 April 2000; 730-750mm 20° 54' N, 103° 37' W). These are first known for the area of our interest. Previous records in the state are by Duellman (1961) at Rancho El Rodeo, Sierra de Ixtlán near San Marcos and 18.4 mi NW Magdalena. The latter two are the nearest to our area, 46km NNE and 71km NW. The Ajijic record (Chapala shore) by Peterson *et al.* (1995), is the easternmost record for the species in the state.

*Ramphotyphlops braminus* (Braminy Blind Snake). This species is considered the most abundant species of snake in Guadalajara City (Ponce and Huerta, in prep.). Examples have been found throughout the city since 1990, even down-



town in the most unlikely habitat, polluted and almost without vegetation (BTM-012). Some were found near the city, in the Santiago River Canyon, where there is less human influence, by Adrián Jacobo-Contreras and other local residents, 28 August 2002, 20° 47' N, 103° 20' W (BTM-011), 11 October 2001, 20° 47' N, 103° 19' W, 1160 m (BTM-013-14). This year at least 6 examples were found in one week during the rainy season, in August.

The oldest known discovery in the state is from El Chante (Chapala lake shore), municipality of Jocotepec, Jalisco, a specimen collected by Lila Dipp (a biology student in UAG at that time) in 1980 (UAGM R-0188). Some other UAGM specimens from the Guadalajara area include Colonia Lomas del Valle, 12 March 1992 (UAGM R-0249); nr Glorieta Minerva, 19 September 1991 (UAGM R--173-4); and Colonia Las Fuentes, 7 October 1991 (UAGM R-0241-2). One record is from the southern coast of Jalisco at Barra de Navided, Jalisco, by SMH-0 22 August 1990 (UAGM R-170). Thirteen more specimens from Guadalajara are in UAGM and BTM.

The first record for the species in the state was for Puerto Vallarta (Dundee and Flores, 1991). The species is now known throughout the central, northern and southern parts of Jalisco.

*Salvadora mexicana* (Duméril, Bibron and Duméril) (Mexican Patchnosed Snake). One (BTM-001) was obtained 8 December 2001, by Mario-Ruvalcaba-Venégas in the municipality of Zapopan, near Guadalajara, in an area of disturbed subtropical scrub forest at 1159m (20° 47' N, 103° 19' W). Former records for the species in the state are limited to coastal areas (García and Ceballos, 1994).

*Storeria storeioides* (Cope) (Mexican Brown Snake). Two specimens were found in the municipality of Chinicuil, Michoacán. One was in an area of cloud forest at 1680m (18° 41' N, 103° 25' W), taken by a local resident, Jesús Bravo-Sánchez, 3 December 2000 (BTM-005). The second was found in oak-pine forest at 1481m (18° 42' N, 103° 23' W), 4 December 2000 (BTM-006), and was photographed and released *in situ*. These are the westernmost records in Michoacán; the nearest record to these localities is about 50km NE, at Dos Aguas, Michoacán (Duellman, 1961).

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## A Note Regarding Defensive Behavior in The Short-headed Gartersnake (*Thamnophis brachystoma*).

Limited information exists regarding antipredator or defensive behavior in *Thamnophis brachystoma*. In their monograph on the gartersnakes, Rossman et al. (1999) makes no mention of antipredator behavior for *T. brachystoma*. Tennant and Bartlett (2000) report that this species is excitable, and not prone to bite. Hulse et al. (2001), in addition to commenting on the short-headed gartersnake never attempting to bite, also states that it will often thrash about violently and release feces and musk. Here I report defensive behavior for *T. brachystoma*, which has not been reported. The observation was made on 6 May 2002, ca. 1100 h, just south of PA 36, and about 12 meters west of the Clarion river at Cook Forest State Park, Cooksburg, Pennsylvania.

An adult female *T. brachystoma* was found beneath a small flat rock. The snake immediately attempted to flee, making rapid undulations with its body. Upon being grasped, it thrashed about, musked, and voided the contents of its cloaca. After ca. 10 seconds of energetic writhing, the individual flattened its body dorsoventrally, opened its mouth, and began repeatedly striking at my left hand. Most of the strikes failed to make contact. Although it struck with its mouth open it never closed its mouth upon hitting my hand, and therefore did not bite. Additionally its teeth never caught onto my skin, nor caused any abrasions. It continued to display this behavior for approximately one minute, until it was placed on the ground and allowed to crawl beneath a rock. Flattening of the body caused the snake to appear larger than it was; whereas open-mouth strikes gave the snake a more threatening appearance. It would be particularly interesting to investigate the prevalence of these behaviors in this population, and also to determine if the behaviors are unique to *T. brachystoma* in this locality.

A second *T. brachystoma*, a mature male, was found in the same area. This individual did not display any behavior that was atypical for the species.

### Acknowledgments

I wish to thank W. Shane Snyder for accompanying me in the field. I would also like to thank the following individuals for reviewing the manuscript and offering comments and or suggestions, Arthur C. Hulse, James Ball, David Chiszar, and Hobart Smith.

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**BOOK REVIEW:** *Wisconsin's Natural Communities: How to Recognize them, Where to Find Them*, by Randy Hoffman, 2002. University of Wisconsin Press, 1930 Monroe St., Madison, Wisconsin, 53711. ISBN 0-299-17080-2, Cloth \$59.95, ISBN 0-299-17084-5, Paper \$24.95.

The author has intended this book primarily for the layman, as scientific names have been excluded from within the text, although the appendix gives both the common and scientific names for those species of mosses, lichens, liverworts, mollusks, snails, and insects not cited in single sources within the text. It truly would have been a more informative volume had the author provided scientific names along with the common names cited throughout the text. Everyone familiar with plants, invertebrates or vertebrate species knows that common names are very unstable, and vary significantly within regions.

The Introduction provides a brief review of the species diversity found within the state of Wisconsin, with insects numbering nearly 40,000 species, while the amphibians and reptiles are lesser represented, with some 53 species. A comparison of acres of the 28 plant communities found within Wisconsin shows that since the mid-1880's, only the Southern Red-Oak mixed forest and Dry Pine forest habitats have increased in dominance into the late 1900's. All other communities have decreased significantly, with Sugar-Maple-Basswood, Mesic Prairie, and Wet-mesic Prairie habitats having been drastically affected. As one would easily surmise, agricultural and urban communities have been the major cause for natural community destruction.

The author divided the book into two sections, with the first section describing the natural communities found within the state of Wisconsin, and part two which describes the 50 sites discussed within the text. Each site is well-illustrated with line drawings and maps which depict the specific locality, along with road direction for each community treated within the text, followed by a list of noteworthy species of plants, insects, herptiles, birds and mammals that are noted for the specific area. The author also provides valuable information on population declines for specific species, along with remarks on habitat destruction, and its implications, and general information on potential species to be encountered in different cite locations.

Eight pages of high quality color plates provide a select overview of certain communities and species, although this coverage could easily have been expanded by eliminating some of the line drawings of specific plants and animals throughout the text, which are of little value.

Overall this excellent book will prove to be a valuable source of information for both professional biologist and laymen alike. I have noted a number of locations

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which I either want to revisit, along with numerous natural communities which I look forward to visiting. I also would recommend this book to anyone traveling through the state with a general interest in nature as it provides a wealth of information and will certainly make routing a specific trip much more enlightening, and productive. Every Wisconsinite should have a copy in his or her home for reference, knowledge, and entertainment.

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**Book Review: Herpetology in Montana**, by Bryce A. Maxell, J. Kirwin Werner, Paul Hendricks and Dennis L. Flath. Northwest Fauna Society for Northwestern Vertebrate Biology (5), 138 pp. Wrs. P.O. Box 22313, Seattle, Washington 98122. \$12.00 + \$1.50 shipping.

The present volume has been a long awaited compendium on the herpetofauna of Montana, and was written nearly 200 years after the first European herpetological observations were cited from this state. In the Introduction, the authors provide a thorough summary of the historical information on Montana from the time of Lewis and Clark's arrival in 1805 to the present. This is followed by a checklist of native species and subspecies, along with dichotomous keys for eggs, larvae, and adults of amphibians along with a key for identification of juvenile and adults of reptiles found within the state. A unique aspect which has not been seen in recent herpetological literature is a chronological summary of articles on the herpetofauna of Montana and Yellowstone National Park between 1800 and 2002, along with a figure showing the number of articles cited in the bibliography with information on the 29 native species and number of voucher specimens observed.

The individual species accounts provide comments on habitat, along with information on the Earliest Literature and Voucher Records, Maximum Elevation, and Voucher Record Summary, followed by a Bibliographic Index which closely follows the Catalogue of American Amphibian and Reptiles Species Accounts in format. Each species has an excellent distributional map having been compiled from information on 3390 amphibian voucher specimens and 1238 reptile voucher specimens amassed from different institutions through 2001, along with several more recent voucher specimens collected during the 2001 and 2002 seasons. The only drawback is the lack of illustrations for any of the species cited within the text, although this should not distract from the usefulness of this badly needed reference work.

Seven species: *Ambystoma tigrinum diaboli*, *Dicamptodon aterrimus*, *Spea intermontana*, *Bufo hemiophrys*, *Rana sylvatica*, *Phrynosoma douglasii* and *Eumeces skiltonianus utahensis* are questionable species having been found in bordering adjacent states, and possibly will be recorded for Montana with further collecting. The authors provide information on the status and closest distributional data related to each of these questionable species, followed by accounts for exotic species or subspecies having been reported from Montana. The below listed species, *Taricha granulosa*, *Bufo canorus*, *Hyla arenicolor*, *Pseudacris clarkii*, *Rana catesbeiana*, *Rana clamitans*, *Clemmys marmorata*, *Trachemys scripta elegans*, *Terrapene carolina triunguis*, *Terrapene ornata*, *Phrynosoma coronatum*, *Phrynosoma platyrhinos*, and *Heterodon platirhinos* are considered exotic species. The major portion of these



species have been cited from translocation populations, or misidentification, and have not become established within the state. A bibliography of 543 citations dealing with the herpetofauna within and immediately adjacent to Montana round out this excellent publication. I would highly recommend this book to anyone having an interest in North American herpetofauna, and especially those living within the state of Montana, as it is without graphical errors, and extremely informative, and will probably remain the standard text for the state for years to come.

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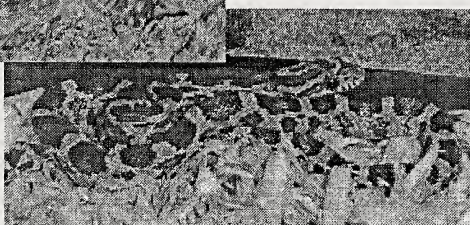
*News and Notes*

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**Landmark Field Guide First for Delmarva's Amphibians and Reptiles**
*Publication Supports Delaware Nature Society's Project on Herpetofauna*

February 1, 2003 — A husband-and-wife team from the Delaware Nature Society has compiled the first-ever guide to amphibians and reptiles of Delmarva. Jim White and Amy Wendt White spent nearly fifteen years combing the region's swamps, woods, and fields.

The result of their work is *Amphibians and Reptiles of Delmarva*, which includes seventy-three species with each account containing a detailed description of physical characteristics, comparisons to similar species, and information on the geographical distribution, abundance, habitat, reproduction and development, and behavior. From skinks to snakes, from turtles to frogs, this compact but thorough reference gathers vital information about the Delmarva Peninsula's herpetofauna. Herpetology is the branch of zoology dealing with reptiles (turtles, lizards, and snakes) and amphibians (salamanders and frogs).

In 1986, Jim White, associate director of land and biodiversity management for the Delaware Nature Society, became a principal investigator in a herpetological survey of the state; this research evolved into the field guide published recently by Tidewater Publishers in association with the Delaware Nature Society. Amy White, who is a teacher-naturalist at the Nature Society, often accompanied her husband on early expeditions. A concerted effort to organize and write the guide commenced in 1998 as she became more involved with the entire project.

"We hope the book instills a strong conservation ethic in the area's residents, an ethic that leads to better protection of these animals and the habitats in which they live," the authors said.

The field guide has already garnered tremendous accolades, including praise from Roger Conant, esteemed Director Emeritus of the Philadelphia Zoo and one of the country's foremost herpetologists. "As a book on the herpetology of a small geographic area, this publication is the most complete and thorough of any I have seen," said Dr. Conant, author of the *Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America*. "Every species and subspecies is described in meticulous detail, and the splendid photographs make identification easy."

Given its size, the Delmarva Peninsula — encompassing all of Delaware, the northeast corner of Maryland and its Eastern Shore, and the eastern shore of Virginia — boasts a rich array of amphibians and reptiles. However, Delmarva's herpetofauna is often overlooked by the vast majority of people living in the area. Many have never heard a northern spring peeper call or seen a salamander, even though a breeding chorus of peepers is common in the spring, and salamanders are residents of most woodlands in Delmarva.

Misconceptions also abound. For example, people sometimes think they have seen "cottonmouths" (water moccasins) on Delmarva, even though this venomous species is not

continued

*News and Notes*

**White and White / *Amphibians and Reptiles of Delmarva***  
Page 2

known to occur north of the mouth of the Chesapeake Bay. Misidentification of species, especially of snakes, is common, Amy White said. "Fear and misunderstanding lead some people to mistake harmless snakes as venomous and they kill them needlessly."

The field guide will be useful to a wide variety of people interested in these fascinating creatures — from the curious child who brings home a salamander to students, experienced naturalists, and professionals in need of life history, behavioral, and distributional information.

"This landmark field guide is an invaluable tool in our mission to educate children and adults about the natural world," said Michael E. Riska, executive director of the Delaware Nature Society. "It will generate interest in Delmarva's fascinating amphibians and reptiles and encourage conservation of all of our native animals and plants and their habitats."

A skilled nature photographer, Jim White routinely captures many species and their environs on film. More than ninety of his pictures are collected in the guide's full-color insert, which serves as a valuable tool for identifying various amphibians and reptiles.

"Dealing with tough environmental conditions often made the photography challenging," White said, referring specifically to photographing frogs. White often stood in water up to his knees, usually at night, sometimes in the rain, and crept as close as he could to the frogs without scaring them away. "Then you have to wait for the frog to call and try to get a good photograph with its throat expanded. It takes a lot of effort and luck."

Jim's favorite species included in the guide is the bright green Barking Treefrog — which graces the book's cover — because he was the first to discover a breeding population of these frogs on Delmarva. Amy's favorite is the warty brown *Bufo americanus americanus*, or more commonly the American Toad, because it serves as a harbinger of spring and is easier to catch than most other frogs. But handlers beware: it secretes a powerful toxin that can be quite unpleasant if it is ingested or comes in contact with the eyes.

Both Jim and Amy White earned degrees from the University of Delaware: Jim in entomology and applied ecology and Amy in environmental engineering. They are members of the Delaware Ornithological Society and Delaware Natural History Society. Jim is also a member of Delaware Partners in Flight and Partners for Amphibian and Reptile Conservation.

Founded in 1964, the Delaware Nature Society ([www.delawarenaturesociety.org](http://www.delawarenaturesociety.org)) fosters understanding, appreciation, and enjoyment of the natural world through education; preserves ecologically significant areas; and advocates stewardship and conservation of natural resources. The Nature Society maintains two nature centers and manages four nature preserves for biodiversity, research, and educational programs. The Nature Society is also the Delaware affiliate of the National Wildlife Federation with input on national issues that concern citizens in the region.

*Amphibians and Reptiles of Delmarva* is available for \$14.95 from booksellers or Tidewater Publishers, P.O. Box 456, Centreville, MD 21617 (800-638-7641).

***Amphibians and Reptiles of Delmarva***  
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*News and Notes*



## Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are \$5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at \$.25/page.

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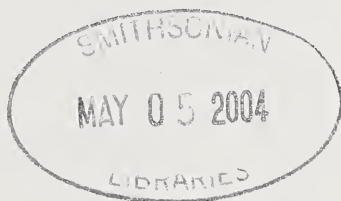
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# Maryland Herpetological Society

DEPARTMENT OF HERPETOLOGY

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30 JUNE 2003

VOLUME 39 NUMBER 2



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Volume 39 Number 2

June 2003

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# BULLETIN OF THE

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The Maryland Herpetological Society  
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Membership in the Maryland Herpetological Society is \$25.00 per year and includes the Bulletin of the Maryland Herpetological Society. Foreign is \$35.00 per year. Make all checks payable to the Natural History Society of Maryland, Inc.

## *Meetings*

Meetings are held monthly and will be announced in the "Herp Talk" newsletter and on the website, [www.naturalhistory.org](http://www.naturalhistory.org).





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## Leptotyphlopidae: Worm Snakes, not Blind Snakes!

Van Wallach

While it is true that the only scientifically relevant names of species are the Latinized generic, specific and subspecific epithets, common names are used (sometimes exclusively) in the secondary and lay literature. Also, numerous papers, monographs and even books have been devoted to listing the common names of reptiles and amphibians. I here make a plea for the correction and standardization of the common names of the scolecophidian blind and worm snakes of the world (Typhlopidae and Leptotyphlopidae).

There is a perplexing confusion with the vernacular nomenclature of these two snake families that dates back many years and I wish to set the record straight for future publications. Table 1, which lists the common names applied to the three scolecophidian families in various publications, illustrates the confusion and lack of standardization in vernacular nomenclature for these snakes. Common names applied to the Leptotyphlopidae include "Worm Snakes," "Blind Snakes," "Slender Blind Snakes," "Thread Snakes," "Earth Snakes," "Earthworm Snakes," "Burrowing Snakes," "Blind Worms," "Bigjawed Blindsnakes," "Ant-nest Worms," and "Ground Puppys." While this article addresses the typhlopoid and leptotyphlopoid situation, a few comments on the anomalepidids are also included. The Typhlopidae (and the closely related Anomalepididae) are "Blind Snakes" and the Leptotyphlopidae are "Worm Snakes" and they should be referred to as such! This is manifestly clear upon a comparative examination of any representatives of the two families. The differences are clearly significant, which is why taxonomists have placed them in separate families since 1891. Three superficial points (body size, coloration, and eye size) should suffice to demonstrate that leptotyphlopids are more worm-like and less blind than typhlopids.

Firstly, leptotyphlopids are smaller in average and maximum size than are typhlopids: shorter in total length, narrower in body diameter, and thinner in body proportion. The maximum length in *Leptotyphlops* is 400 mm (*L. macrolepis*) with only eight species (*L. anthracinus*, *L. humilis*, *L. maximus*, *L. melanotermus*, *L. occidentalis*, *L. septemstriatus*, *L. tricolor*, *L. weyrauchi*) reaching a maximum length of 300 mm or longer. Average length in leptotyphlopids is about 150 mm with a midbody diameter of 3 mm. On the other hand, 15 typhlopids reach more than 600 mm in length (*Ramphotyphlops nigrescens*, *R. proximus*, *R. unguistrostris*, *R. waitii*, *Rhinotyphlops acutus*, *R. mucruso*, *R. schlegelii*, *R. somalicus*, *T. angolensis*, *T. congestus*, *T. decorsei*, *T. lineolatus*, *T. punctatus*, *T. schmidtii*, *T. usambaricus*) with

Table 1. Chronological comparison of vernacular names for the three *Scolecophidian* families

Source	<u>Leptotyphlopidae</u>	<u>Typhlopidae</u>	<u>Anomalepididae</u>
Van Denburgh, 1897	Worm Snakes		
Ditmars, 1910, 1933	Worm Snakes		
Van Denburgh, 1922	Worm-snakes		
Rose, 1929, 1950, 1955, 1962	Thread Snakes	Earth Snakes	
Flower, 1933	Earth-Snake	Blind-Snake	
Curran & Kauffeld, 1937	Blind Snakes		
Pope, 1937	Worm- or Blind Snakes	Worm- or Blind Snakes	
Pitman, 1938, 1974	Worm-Snakes	Blind-Snakes	
Conant & Bridges, 1939	Blind Snakes		
Ditmars, 1939	Blind Snakes		
Klauber, 1940	Worm Snakes		
Schmidt & Davis, 1941	Blind Snakes		
Beebe, 1946	Worm Snakes	Blind Snakes	
Beebe, 1946	Ant-nest Worms	Burrowing or Ant Snakes	
Hill, 1948	Blind Snakes		
Perkins, 1949	Worm Snakes		
Smith, 1950	Blind Snakes		
Wright, 1950	Worm Snakes		
Stebbins, 1954	Worm Snakes		
Oliver, 1955	Blind Snakes		

Table 1. Continued

Source	Leptotyphlopidae	Typhlopidae	Anomalepididae
Pope, 1955	Blind Snakes	Blind Snakes	
Conant et al., 1956	Slender Blind Snakes		
Blair et al., 1957	Blind Snakes		
Schmidt & Inger, 1957	Slender Blind Snakes		
Wright & Wright, 1957	Blind or Worm Snakes		
Conant, 1958, 1975	Slender Blind Snakes		
Khalaf, 1959	Earthworm Snakes	Blind or Worm Snakes	
Mertens, 1960	Thread-snakes		
Sweeney, 1961	Worm-snakes	Blind Burrowing Reptiles	
FitzSimons, 1962	Worm—Snakes	Blind Snakes	
FitzSimons, 1962	Thread-Snakes	"	
Goin & Goin, 1962, 1971	Slender Blind Snakes		
Goin & Goin, 1962, 1971	Thread Snakes		
Parker, 1963, 1965	Thread-snakes	Blind-snakes	
Lowe, 1964	Blind or Worm Snakes		
Banta, 1965	Worm Snakes		
Fowlie, 1965	Worm Snakes		
Pienaar & FitzSimons, 1966	Worm or Thread Snakes	Blind Snakes	
Stebbins, 1966, 1985	Slender Blind Snakes		
Dixon, 1967	Worm Snakes		
Grzimek, 1968	Slender Blind Snakes		
Bellairs, 1969, 1970	Blind-, Worm- or Thread-snakes		Blind or Worm-snakes



Table 1. Continued

<u>Source</u>	<u>Leptotyphlopidae</u>	<u>Typhlopidae</u>	<u>Anomalepididae</u>
Cochran & Goin, 1970	Slender Blind Snakes		
Leviton, 1970	Slender Blind Snakes		
Webb, 1970	Blind Snakes		
Porter, 1972	Blind Snakes	Worm Snakes	
Skinner, 1973	Worm-, Thread- or Earth-snakes		Blind-snakes
Skinner, 1973	Blind-worms	"	
Brown, 1974	Blind or Worm Snakes		
Collins, 1974, 1982	Blind Snakes		
McKeown, 1974	Blind Snakes		
Shaw & Campbell, 1974	Slender Blind Snakes		
Dowling, 1975	Slender Blindsnakes	Typical Blindsnakes	Primitive Blindsnakes
Gans, 1975	Slender Blind Snakes	Blind Snakes	
Heymann, 1975	Blind Snake		
Emsley, 1977	Worm Snakes	Worm Snakes	
Parker & Grandison, 1977	Thread Snakes	Blind Snakes	
Smith et al., 1977	Bigjawed Blindsnakes	Weakjawed Blindsnakes	Dawn Blindsnakes
Pienaar et al., 1978, 1983	Worm Snakes	Blind Snakes	
Arnold & Burton, 1978		Worm Snakes	
Collins et al., 1978	Blind Snakes		
Webb et al., 1978	Thread Snakes	Blind Snakes	
Hahn, 1979	Slender Blind Snakes		

Table 1. Continued

<u>Source</u>	<u>Leptotyphlopidae</u>	<u>Typhlopidae</u>	<u>Anomalepididae</u>
Behler & King, 1979	Slender Blind Snakes		
Stucki-Sturm, 1979	Worm Snakes	Glass or Blind Snakes	
Englemann & Obst, 1981	Slender Blind Snakes	Worm or True Blind Snakes	
Englemann & Obst, 1981	Thread Snakes	Worm Blind Snakes	
Grater, 1981	Blind or Worm Snakes		
Pinney, 1981	Blind Snakes		
Abuys, 1982	Worm Snakes	Worm Snakes	Worm Snakes
Collins et al., 1982	Blind Snakes		
MacLean, 1982		Worm or Blind Snakes	
Smith & Brodie, 1982	Blind Snakes		
Ballinger & Lynch, 1983	Slender Blind Snakes		
Ballinger & Lynch, 1983	Thread Snakes		
FitzSimons & Broadley, 1983, 1990		Worm- or Thread-Snakes	Blind Snakes
FitzSimons & Broadley, 1983, 1990		Slender Blind-Snakes	"
Tennant, 1984	Blind Snakes		
Tennant, 1985	Slender Blind Snakes		
Thomas et al., 1985	Thread Snakes		
Adler & Halliday, 1986	Thread Snakes	Typical Blind Snakes	Dawn Blind Snakes
De Lisle et al., 1986	Blind Snakes		
Mattison, 1986	Blind Snakes	Worm or Blind Snakes	
Patterson, 1986, 1987	Worm or Thread Snakes	Blind Snakes	

Table 1. Continued

Source	Leptotyphlopidae	Typhlopidae	Anomalepididae
Vermersch & Kuntz, 1986	Blind Snakes		
Jennings, 1987	Slender Blind Snakes		
Branch, 1988, 1991, 1993, 1994, 1998	Thread or Worm Snakes	Thread Snakes	Blind Snakes
Gasperetti, 1988	Blind Snakes	Blind Snakes	
Sievert & Sievert, 1988	Thread Snakes		
Gallagher, 1990, 1993	Blind Snakes	Blind Snakes	
Collins, 1990, 1997	Thread Snakes	Blind Snakes	
Burton, 1991	Blind Snakes		
Collins & Collins, 1991	Slender Blind Snakes		
Conant & Collins, 1991	Slender Blind Snakes	Typical Blind Snakes	Dawn Blind Snakes
Weidensaul, 1991	Thread Snakes	"	"
Weidensaul, 1991	Slender Thread Snakes	Blind Snakes	
Brazaitis & Watanabe, 1992	Thread Snakes	Blind Snakes	
Marais, 1992, 1999	Slender Blind Snakes		
Collins, 1993	Blind Snakes		
Stoops & Wright, 1993	Thread Blindsnakes	Blindsnakes	Blindsnakes
Zug, 1993	Wormsnakes	"	"
Zug, 1993	Slender Blind Snakes	Blind Worm Snakes	
Liner, 1994	Blind Snakes		
Williamson et al., 1994	Blind Snakes		
Cox & Tanner, 1995	Blind Snakes		



Table 1. Continued

<u>Source</u>	<u>Leptotyphlopidae</u>	<u>Typhlopidae</u>	<u>Anomalepididae</u>
Frank & Ramus, 1995	Slender Blind Snakes	Blind Worm Snakes	
Mattison, 1995a-b, 1999	Thread Snakes	Blind Snakes	
Holman, 1995, 2000	Slender Blind Snakes		
Holman, 1995, 2000	Thread Snakes		
Rossi & Rosssi, 1995	Blind Snakes		
Barnard, 1996	Thread Snakes	Blind Burrowing Snakes	
Degenhardt et al., 1996	Blind Snakes		
Lee, 1996, 2000	Slender Blind Snakes	Blind Snakes	
Marven & Harvey, 1996	Thread Snakes	Blind Snakes	
Baran & Atatür, 1997	Blindsnakes	Worm Snakes	
Brown, 1997	Slender Blind Snakes		
Greene, 1997	Blind Snakes	Blind Snakes	
Murphy, 1997	Thread Snakes	Typical Blind Snakes	Dawn Blind Snakes
Campbell, 1998	Thread Snakes	Blind Snakes	
Conant & Collins, 1998	Blind Snakes	Blind Snakes	
Tennant, 1998	Blind Snakes	Blind Snakes	
Behler, 1999	Slender Blind Snakes		
Bartlett & Tennant, 1999	Slender Blind Snakes	Blind or Worm Snakes	
Chan-ard et al., 1999		Worm Snakes	Blind or Worm Snakes
Kornacker, 1999	Blind Snakes	Blind Snakes	
Tennant & Bartlett, 1999	Slender Blind Snakes		

Table 1. Continued

Source	<u>Leptotyphlopidae</u>	<u>Typhlopidae</u>	<u>Anomalepididae</u>
Crother, 2000	Threadsnakes		
McPeak, 2000	Slender Blind Snakes		
Werler & Dixon, 2000	Blind Snakes		
Boos, 2001	Ground Puppys	Blind or Burrowing Snakes	Ground Puppys
Bouskila & Amitai, 2001	Blind Snakes	Worm Snakes	
Leenders, 2001	Slender Blindsnakes	True Blindsnakes	Neotropical Blindsnakes
O'Shea & Halliday, 2001	Blindsnakes	Blindsnakes	Lesser Blindsnakes
Ricciuti, 2001	Thread Blindsnakes	Blind Snakes	Dawn Blind Snakes
Zug et al., 2001	Threadsnakes	Blindsnakes	Early Blindsnakes
Zug et al., 2001	Wormsnakes	"	"
Collins & Taggart, 2002	Blind Snakes		
Grismer, 2002	Blind Snakes		
Khan, 2002	Thread Snakes	Blind Snakes	
Khan, 2002	Worm Snakes	Worm Snakes	
Savage, 2002	Thread Snakes	Blind Snakes	Blind Worm Snakes

a maximum length of 950 mm in *Rhinotyphlops mucruso*. The average length of typhlopids is about 300 mm with a midbody diameter of 10 mm. The thinnest of all scolecophidians are 11 African *Leptotyphlops* (with length/width ratios of 100-140), which is why they are often called "Thread Snakes," while the stoutest of all are some African and South American *Typhlops* (with length/width ratios of less than 20).

Secondly, leptotyphlopids resemble worms in coloration (usually pink or beige) more than typhlopids do (which are generally brown to black). Many leptotyphlopids lack pigmentation and appear pink in coloration due to subcutaneous capillary beds. Most typhlopids are heavily pigmented in shades of gold, brown or black, often with a pattern of contrasting colors forming stripes, spots, or blotches. Superficially, *Leptotyphlops* resembles earthworms in all ways except the presence of scales.

The following examples illustrate why leptotyphlopids should be called "Worm Snakes." Schmidt and Davis (1941), although naming the Leptotyphlopidae "Blind Snakes," remarked that they "are strikingly similar to earthworms." In their defence it must be mentioned that members of the genus *Carphophis* are also termed "Worm Snakes." This is a prime example of the inadequacy of common names! Oliver (1955), Heymann (1975), and Grater (1981) called *Leptotyphlops* "Blind Snakes" but mentioned that they were often mistaken for earthworms. Stoops and Wright (1993) classified *Leptotyphlops* as "Blind Snakes" but went on to explain that they are also "called worm snakes because that is exactly how they appear—small, slender, and resembling worms." Degenhardt et al. (1996) labelled the Leptotyphlopidae as "Blind Snakes" but mentioned that they are often called "Wormsnakes." Even more ambiguous are Conant and Bridges (1939) who referred to the Leptotyphlopidae as "Blind Snakes" but listed *Leptotyphlops dulcis* as the "Texas Worm Snake."

Thirdly, leptotyphlopids have much larger and better developed eyes than any typhlopids, which are blind to a greater degree than *Leptotyphlops* based upon relative eye size and presence of a distinct pupil. All *Leptotyphlops* have a moderate to large scolecophidian eye with a distinct pupil; all typhlopids have either a small eye with a pupil, a solid black eyespot (faint in some species), or no visible eye at all. A few species of *Ramphotyphlops* and *Typhlops* have eyespots that are very faint or only visible in juveniles but the only truly blind typhlopids are members of the genus *Rhinotyphlops*. Whereas the eyes are located beneath a large head shield in all scolecophidians, several groups of *Leptotyphlops* (such as the Neotropical *albifrons* species group and the African *L. macrops*) have the eye bulging out from the contour of the head. The relative eye diameter in comparison with head depth averages from



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0.25-0.33 in *Leptotyphlops* and less than 0.10 in *Typhlops*.

Leptotyphlopids definitely resemble worms much more than typhlopids do, and typhlopids are more blind than leptotyphlopids. Thus the most accurate and descriptive common name for the Leptotyphlopidae is "Worm Snake" and that of the Typhlopidae is "Blind Snake." "Thread Snake" is not as accurate a name as "Worm Snake" because some species of *Leptotyphlops* are thick-bodied with length/width ratios of 30 or less.

Klauber (1940) revised the genus *Leptotyphlops* and he was the first to correctly use the appellation "Worm Snakes." Modern authors continue to refer to North American *Leptotyphlops* as "Blind Snakes" (Tennant, 1984; Williamson et al., 1994; Rossi and Rossi, 1995; Werler and Dixon, 2000; Grismer, 2002). Even more troubling is that the official vernacular indices of the USA have continued to refer to *Leptotyphlops* as "Blind Snakes" (Collins et al., 1978; Collins et al., 1982; Collins, 1990, 1997; Collins and Taggart, 2002) or "Threadsnakes" (Crother, 2000). The usage of "Blind Snakes" for *Leptotyphlops* probably stems from Conant et al. (1956), who termed them "Slender Blind Snakes." This inaccurate terminology has been perpetuated by the entire Peterson field guide series (Conant, 1958, 1975, Stebbins, 1966, 1985, and Conant and Collins, 1991), the Gulf field guide series (Tennant, 1985; Brown, 1997; Bartlett and Tennant, 1999; Tennant and Bartlett, 1999), the Audubon Society field guide series (Behler and King, 1979; Behler, 1999), and others (Hahn, 1979).

The most ambiguous case in nomenclature is that by Liner (1994) and Frank and Ramus (1995) wherein they referred to the Leptotyphlopidae as "Slender Blind Snakes" and the Typhlopidae as "Blind Worm Snakes," although Skinner (1973) labelled *Leptotyphlops* as "Worm-snakes, Thread-snakes, Earth-snakes, and Blind-worms" in the same breath! Tennant (1998) has even transferred the leptotyphlopoid "Blind Snakes" to the Typhlopidae! Some authors (Conant and Collins, 1998; Tennant and Bartlett, 1999) lumped the two families together and called both the Typhlopidae and Leptotyphlopidae "Blind Snakes" but Emsley (1977) labelled both *Typhlops* and *Leptotyphlops* as "Worm Snakes." Greene (1997) labelled both families as "Blindsnakes" but also referred to African *Leptotyphlops* as "Threadsnakes." Although Adler and Halliday (1986) and Stidworthy (1989) termed the Leptotyphlopidae as "Thread Snakes," they referred to *Leptotyphlops dulcis* as a "Blind Snake." Brazaitis and Watanabe (1992, 1993) used "Slender Thread Snakes" for African *Leptotyphlops* and "Blind Snakes" for the Typhlopidae, but then termed *Ramphotyphlops braminus* a "Worm Snake." Chan-ard et al. (1999) referred to *Typhlops* as "Blind Snakes" but *Ramphotyphlops* as "Worm Snakes." Liner (1994) called *Typhlops* "Common Blind

Worm Snakes” but listed *Ramphotyphlops braminus*, whose universally known common names are either the “Flowerpot or Brahminy Blind Snake,” as the “Longtail Blind Snake.” Khan (2002) called the Leptotyphlopidae and Typhlopidae “Worm Snakes” and then referred to the Leptotyphlopidae as “Thread Snakes” and the Typhlopidae as “Blind Snakes.”

It is obvious, as every systematist knows, that there is no standardization for vernacular names, and this is especially evident in the Scolecophidia. I appeal for a more consistent and accurate terminology for the common names of leptotyphlopids and typhlopids. In an effort to be as descriptive as possible, all accounts and checklists should refer to the Leptotyphlopidae as “Worm Snakes” and the Typhlopidae as “Blind Snakes.” The question of how to deal with the nomenclature of the two species of alethinophidian “Worm Snakes” (*Carphophis amoenus* and *C. vermis*) remains unanswered. The resemblance of *Carphophis* to earthworms is limited to their size and natural habitat. I suggest an alternative common name be applied to this genus.

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## Presence of the Río Fuerte Beaded Lizard (*Heloderma horridum exasperatum*) in Western Chihuahua

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*Heloderma horridum exasperatum* was described by Bogert and Martín del campo (1956) on the basis of fifteen specimens and one incomplete skin, all from three localities in the Río Fuerte drainage basin of southern Sonora and northern Sinaloa. Additional records for Sonora and Sinaloa are reported by Hale (1989), Hardy and McDiarmid (1969) and Ottley (1981a and 1981b). Bogert and Martín del Campo (1956) mentioned that this subspecies of beaded lizard should range eastward into the barrancas of western Chihuahua. Recent field work in the regions known as Cañón de Chínipas and Barranca de Batopilas has revealed the presence of beaded lizards in several localities of western Chihuahua (Figure 1).

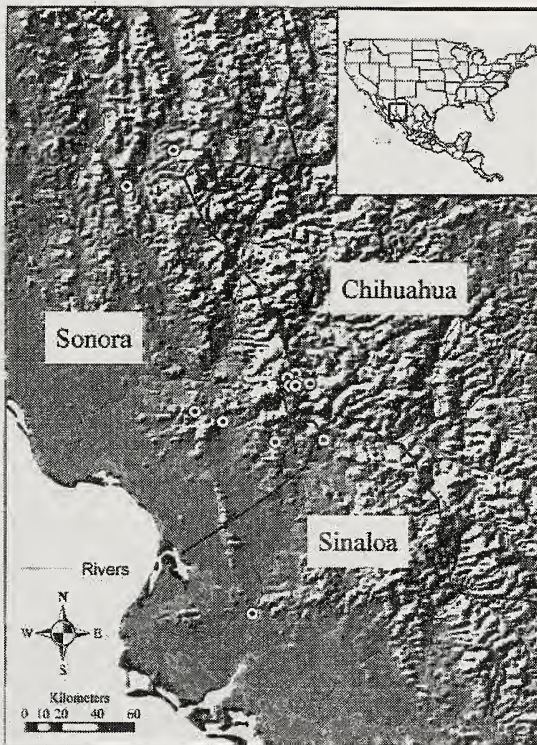


Fig. 1. Localities of record (round white dots with a black center) for *H. h. exasperatum*. Note the correlation with foothill contours.



In October 2002 JLE surveyed the herpetology of the vicinity of the town of Chínipas, Chihuahua. Local residents kindly offered to help us with the survey, and told us about the presence of beaded lizards, locally called “escorpiones,” in the mountains that surround the town. All these natives considered the “escorpiones” as extremely poisonous lizards which should be killed to prevent being bitten by them. Natives have the belief that the skin of “escorpiones” is useful as a cure for snake-bites. When a beaded lizard is killed, the skin is removed and stored to use as medicine. In addition to efforts to find specimens of *H. h. exasperatum* in the field, *Hemoderma* skins were sought in all the villages around the town of Chínipas (Figure 2). Although we failed to find specimens in the field, we were able to establish the presence of *H. h. exasperatum* through nine skins collected in several localities (Table 1).

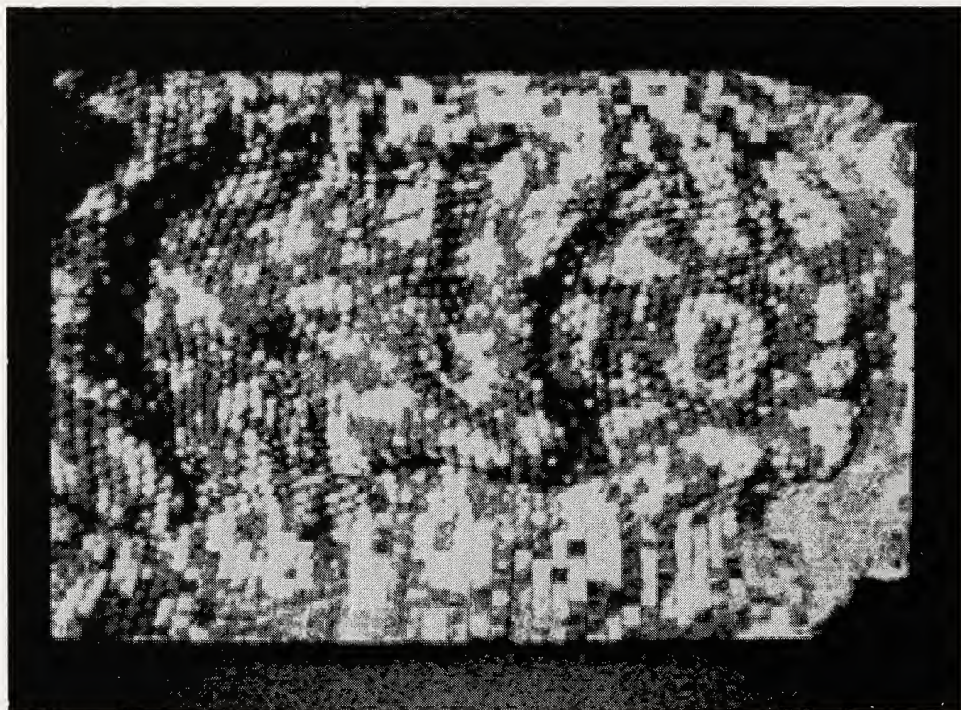


Fig. 2. One of the skins from the vicinity of the Chínipas area. The pattern characteristic diagnostic of *H. h. exasperatum* is the approximate equality of light and pigmented areas, as shown here.

Table 1. Summary of localities where *H. h. exasperatum* has been recorded.

Number	Locality	Coordinates	Elevation	Source
<b>Chihuahua:</b>				
UBIPRO10667	Agua Caliente	27°27'28.0"N 108°31'40.9"W	572	This note
UBIPRO10616	Agua Salada	27°22'54.1"N 108°28'8.6"W	536	This note
UBIPRO10609	(Chínipas) Casa Colorada	27°24'13.0"N 108°31'56.2"W	528	This note
UBIPRO10661	El Limón	27°24'1.0"N 108°32'36.0"W	451	This note
UBIPRO10663-6	La Ciénega	27°27'27.5"N 108°34'50.9"W	600	This note
UBIPRO10662	Machahuivo	27°25'1.1"N 108°33'43.6"W	547	This note
UBIPRO10660	Mesa El Rosario	27°22'48.0"N 108°32'41.1"W	469	This note
UBIPRO10668	Palmarejo	27°23'51.1"N 108°24'32.7"W	615	This note
<b>Sinaloa:</b>				
USNM38116	San Blas	26°4'35.7"N 108°45'45"W	100	Bogert and Martín del Campo (1956)
Not Given	13 kms NNE Baca	26°54'3.2"N 108°23'38.2"W	400	Hardy and McDiarmid (1969)
<b>Sonora:</b>				
AMNH64220-4	Alamos	27°1'21.1"N 108°56'21.8"W	450	Bogert and Martín del Campo (1956)
Not Given	Between Tonichi and Nuri,Hwy Mex. 16.	28°24'35.7"N 108°13'28.2"W	Not given	Hale (1989)
AMNH63698-0 MVZ 50863 63703	Guiracoba	26°54'11.3"N 108°41'33.0"W	450	Bogert and Martín del Campo (1956)
Not Given	Movas	28°9'43.8"N 109°26'21.8"W	Not Given	Ottley (1981a)
Not Given	16.8 kms NNW Alamos	27°5'9.7"N 109°5'3.6"W	Not Given	Ottley (1981b)



These records constitute the first evidence of the presence of this subspecies of beaded lizard in Chihuahua and extends its range ~58 km northeastward of the town of Alamos, Sonora.

In addition to these records, JLE has been working in the Barranca de Batopilas for several years. Local people in this region are quite familiar with “escorpiones,” which are nevertheless considered rare and can be seen only once in a while. Searches for *H. h. exasperatum* in this region unfortunately have failed to find specimens in the field, or to find any other evidence (e.g. skins) of the presence of this subspecies. However, we are positive that beaded lizards occur there.

Specimens from Chínipas, Chihuahua, are deposited in the herpetological collection of Unidad de Biología, Tecnología y Prototipos – UNAM (UBIPRO).

#### Acknowledgments.

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## Reproductive Biology and Population Structure of *Eurycea longicauda longicauda*

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### Abstract

The reproductive biology and population structure of the salamander *Eurycea longicauda longicauda* (Family Plethodontidae) was studied at three sites in southern Illinois to determine possible microgeographic variation. Males matured at  $\geq 46$  mm SVL while females matured at  $\geq 49$  mm snout-vent length (SVL) with both at two years of age. Surface activity was from late February through late November. Mating occurred in October and November with oviposition from November through early January. Adults were much more abundant in the summer months and than juveniles.

### Introduction

Salamander ovarian and testicular cycles have typically been described by monthly "vertical" sampling (Tilley, 1977) with gonadal examinations to determine seasonal changes in reproductive tracts. Interpretations of the reproductive biology (breeding periods, oviposition periods, etc.) of the longtailed salamander *Eurycea longicauda longicauda* (Green) have been made with limited monthly samples/year and or few animals (Mohr, 1943; Hutchinson, 1956; Franz, 1964; Anderson and Martino, 1966; Guttman, 1989; Petranka, 1998). Ireland (1974) described the spermatogenic and ovarian cycles and Trauth et al. (1993) described the caudal hedonic glands of *E. l. melanopleura*. In southern Illinois, Williams et al. (1984, 1985) described the spermatogenic cycle and seasonal changes in cloacal glands of *E. l. longicauda* and found reproduction to be late October while Phillips et al. (1999) stated that oviposition was in underground crevices in late summer and autumn. The ovarian cycle and population structure of *E. l. longicauda* have yet to be fully described. Our purposes were to investigate the reproductive biology (especially the ovarian cycle) and the population structure of *E. l. longicauda* in southern Illinois.

### Material and Methods

Metamorphosed salamanders were sampled monthly at three sites in southern Illinois; a woodland stream leading from a rock shelter 11 km N of Glendale, Pope

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Key Words: *Eurycea*, reproductive biology, ovarian cycle, oviposition period, population structure, southern Illinois

Co. (Pope Co. A), another woodland stream without a rockface in Pope Co. 3 km E of Rosebud (Pope Co. B) and a cave 10 km E of Cobden, Union Co. We collected a monthly sample of at least  $N = 20$  from all three sites combined. At Pope Co. A 124 salamanders were collected from May 1976 through April 1977 and at Pope Co. B 32 were found in March and April 1982. At Union Co. cave 29 were found during May, July, and August 1976, and principally August ( $N = 22$ ) at an adjoining woodland stream. A small series of larvae was collected during March 1976 at the cave and identified as *E. l. longicauda*. Salamanders were hand collected from beneath rocks within 1-2 m of the streamsides and on the cave wall surfaces.

Salamanders ( $N = 185$ ) were euthanized by emersion in 10% chloretone within 48 hr of capture, fixed and preserved in 10% formalin. Vasa deferentia, testes and oviductal widths of mature adults were measured to the nearest 0.25 mm with a Nikon dissecting stereomicroscope equipped with an ocular micrometer to determine seasonal size differences. Gonads of individuals  $\geq 35$  mm SVL (which is the distance from the tip of the snout to the posterior margin of the vent) were examined to determine sexual maturity and reproductive condition in males by degree of testicular pigmentation and vasa deferentia shape and degree of pigmentation. Previous studies have shown that they mature at slightly less than 50 mm SVL (Anderson and Martino, 1966). Female sexual maturity and reproductive condition were determined by ovarian follicle diameter and yoliness and oviductal shape and width (Anderson and Martino, 1966). A random subset ( $N = 25$  or more) of ovarian follicles from each mature female was measured to the nearest 0.5 mm. The vitellogenic cycle at Pope Co. A and Union Co. cave was determined from adult female monthly mean follicle diameter described by a regression equation with significance at  $P < 0.01$ . An F test was used to determine positive correlation between ova development and month of collection. The population structure at Pope Co. A and Union Co. cave was determined by analysis of monthly frequency histograms of each individual snout-vent length. Voucher specimens are deposited at the Southern Illinois University at Carbondale Fluid Vertebrate Collection.

### Results

Juvenile males ( $\leq 45$  mm SVL) had unconvoluted, unpigmented or lightly pigmented vasa deferentia and unpigmented (white) or partially ( $< 75\%$ ) lightly pigmented testes. Mature males ( $N = 65$ ) with convoluted heavily pigmented vasa deferentia and heavily pigmented testes were  $\geq 46$  mm SVL, although one individual from Pope Co. B matured at 44 mm SVL. All mature males from March through May had thin vasa deferentia (approximately 0.25 mm wide) and testes (approximately 1.25 mm wide). Testes began increasing in width in July, were widest in August and Sep-



tember (2.25 mm) and by early October were 1.25 mm and thin (evacuated). By early October males had very thick vasa deferentia (approximately 1.0 mm wide) packed with sperm, which indicated that mating probably occurred in October or November. Mature males from any given month had testes with unimodal width distributions indicating an annual breeding cycle. Juvenile females (< 49 mm SVL) had small unyolked (previtellogenic) follicles and thin straight oviducts. Females ( $N = 47$ ) from all three sites with large yellow yolky ovarian follicles or thick, convoluted oviducts were considered mature. Only females  $\geq 49$  mm SVL from Pope Co. A and Union Co. cave from all months sampled (Fig. 1) showed vitellogenesis, hence, female sexual maturity at these two sites was achieved by this size. All adult females from

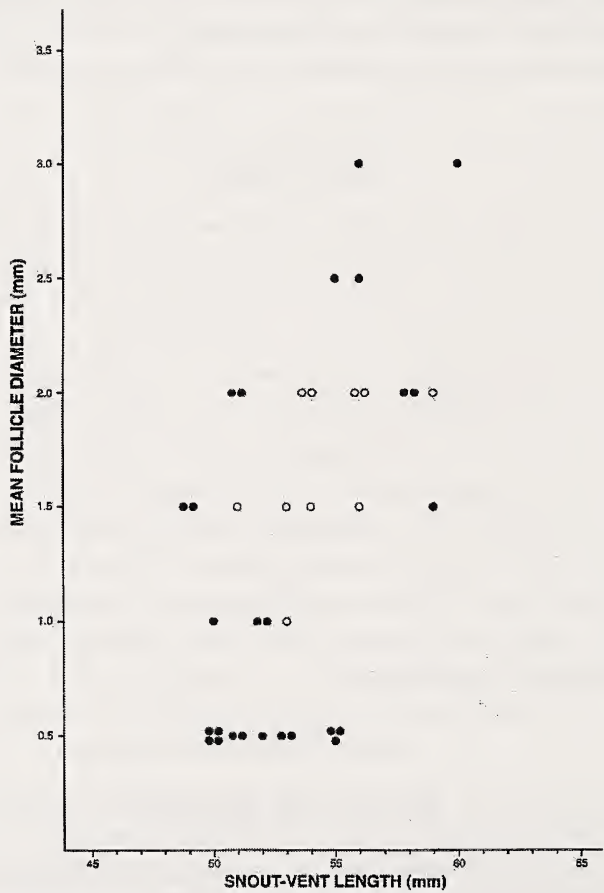


FIG. 1. Female follicle diameter from Pope Co. A (solid circles) and Union Co. cave stream (empty circles) from May 1976 through April 1977 as a function of snout-vent length. Each circle represents mean follicle size of one female.

February through June had small ova (0.5 mm), thin but convoluted oviducts and spent ovaries. Vitellogenesis (Fig. 2) began during July and before mating when mean follicle diameter (1.2 mm) more than doubled in size from June (0.5 mm). Mean follicle diameter increased to 2.4 mm by September and October with oviductal widths thickest in October. Monthly follicle diameters from females at Union Co. cave (Fig. 2) agree well with those from Pope Co A indicating no microgeographic variation. Monthly changes in ovum size were significantly different ( $F = 29.3, P < 0.01$ ) with follicle diameters in late spring small and increasing diameters in summer and fall. Month of collection accounted for almost 90% of the variation in individual female mean follicle size. Follicle diameter size variance was greatest in September and

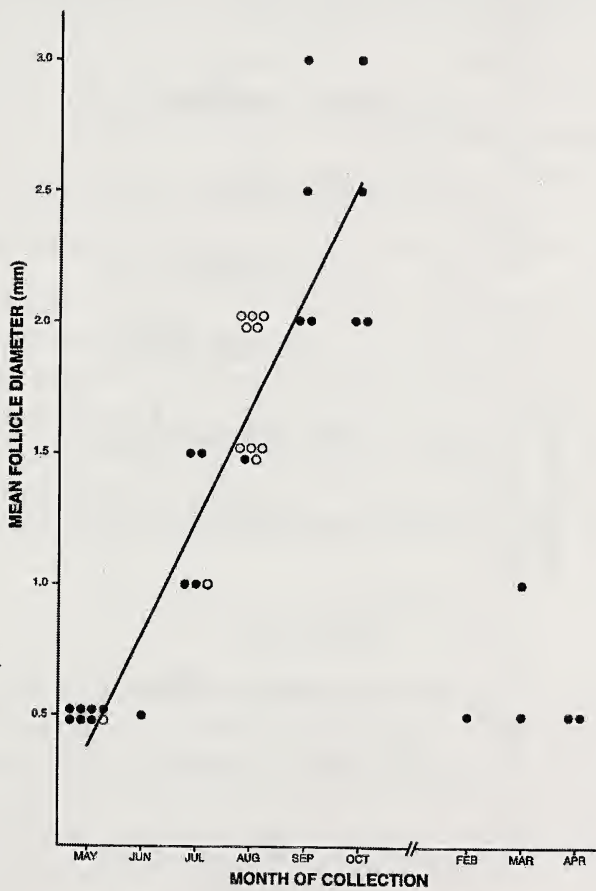


FIG. 2. Vitellogenesis of females from Pope Co. A (solid circles) and Union Co. cave stream (empty circles) from May 1976 through April 1977. Each circle represents mean follicle size of one female. The line fits the regression equation  $Y = -0.05 + .043X$  and  $r^2 = 0.88$ .

October as mean diameters increased. Monthly mean ovarian follicle diameters at Pope Co. A were unimodal in distribution (only one size present in any monthly sample) indicating an annual female breeding cycle. Because all adult females from Pope Co. A in late October were gravid, and all those in late February and March were spent, we suggest that oviposition occurred from November through possibly early January at this site and base the mean oviposition date as December first. Fifteen larval hatchlings ( $\bar{x}$  = 10.5 mm SVL) from the Union Co. cave were collected on 13 March 1976.

The population structure at Pope Co. A and Union Co. cave (Fig. 3) had distinctive size groups that are interpreted as age classes. First year juveniles were found from July through November. Four small juveniles (24-29 mm SVL) from July were

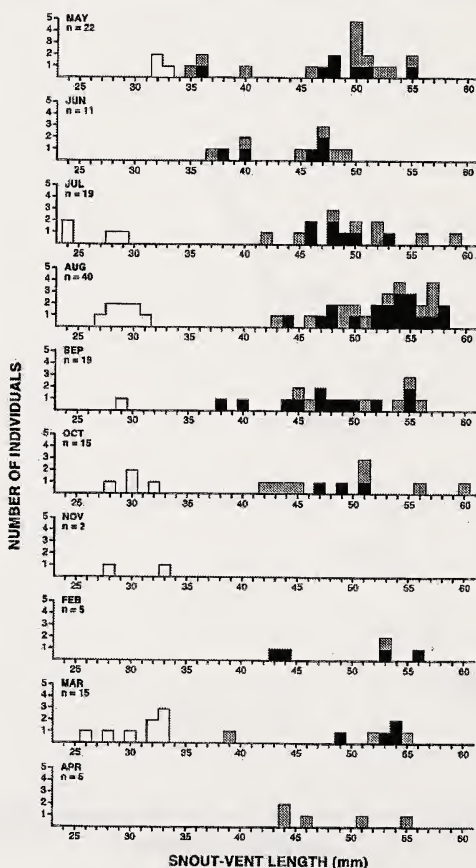


FIG. 3. Population structure at Pope Co. A and Union Co. cave stream. Open squares depict non-dissected juveniles, gray squares are females (including both adults and immatures) and dark squares are males (including both adults and immatures).



presumably recent metamorphs as larval metamorphosis occurred during July 1976 at Pope Co. A (McDowell, 1989). Slightly larger juveniles (to 32 mm SVL) were found in the following months. Juveniles 28-32 mm SVL from October 1976 would be 10 months old based on the estimated December first mean ovipositional date and are about the same size as those from March 1977, but this is probably the result of no or little growth during winter. Juveniles 26-33 mm SVL from March 1977 were a spring 1976 cohort which had overwintered and would be 11 months old. Juveniles 32-36 mm SVL from May would be 16 months old while October individuals 42-45 mm SVL would be 20 months old. They would mature in the following winter or spring. Juveniles had a size range of 24-46 mm SVL. During July and August few second year juveniles were found which was due to samples skewed for adults and first year juveniles. Based on age determinations correlated with gonadal examination data, males and females would mature in the spring of their second year and reproduce for the first time in the following fall or early winter. Adults ( $N = 94$ ; sex ratio 1.4 : 1.0) were much more common in the summer months (especially August) and more common than juveniles (1.6 : 1.0). Females grew to a larger size (to 60 mm SVL) than males exhibiting SSD (sexual size dimorphism). Few salamanders were collected from November through February but they were common in early spring, summer, and fall.

At Pope Co. B adult females ( $N = 10$ ) from March and April had follicle diameters with bimodal distributions. Six mature females with ova 0.5 mm were spent and had thin oviducts while four other mature females had much larger ova (2.0-2.5 mm) and ranged from 47-54 mm SVL. These larger ova were atretic, being lightly brownish, collapsed, very flaccid and were carried over winter. The smallest mature female (47 mm SVL) had presumably undergone vitellogenesis for the first time. All mature males ( $N = 14$ ) had thin vasa deferentia and testes. Eight juveniles and no metamorphs were collected

### Discussion

Several new interesting findings were derived from our study. The surface population at Pope Co. A was more active throughout the year than those found in previous studies (Anderson and Martino, 1966; Guttman, 1989; Petranksa, 1998). Salamanders from Pope Co. A were found from late February through late November. Anderson and Martino (1966) found that the earliest spring emergence at temporary ponds in New Jersey was late April or early May with animals in underground retreats by the end of October. Guttman (1989) found surface activity to end during August in Ohio. The longer seasonal activity present in our study populations may be due to the milder winters in southern Illinois. All salamanders at both stream localities were collected streamside and not away from water. Attempts were made to col-

lect salamanders in nearby woodland areas but failed, contrary to the study by Anderson and Martino (1966) who found them away from water sites. Sizes at maturity also differed from those found in previous studies. Males matured at  $\geq 46$  mm SVL (although one male from Pope Co. B matured at 44 mm SVL) and females at  $\geq 49$  mm SVL (although one female from Pope Co. B matured at 47 mm SVL). Anderson and Martino (1966) found males to mature at 43-45 mm SVL and females at 47 mm SVL and both at three years. We found our adults to mature at two years. Metamorph sizes from July correlate well with those of Anderson and Martino's (1966), however they indicated that juveniles were much more abundant than in our study.

Other studies have also indicated a fall or winter reproductive season. Bishop (1943) in New York described courtship in the laboratory on 18 November while Cooper (1960) observed courtship in Maryland in the field on 18 October. Mohr (1943) found deposited eggs in Pennsylvania in early developmental stages on 2 January while Franz (1964) found deposited eggs in Maryland on 23 November. Anderson and Martino (1966) reported oviposition in January. Oviposition of our salamander populations in southern Illinois correlate well with the preceding observations but seemed to occur later in the year (November through early January) than reported by Phillips et al. (1999) who believed that oviposition occurred in late summer and fall. The brief description by Guttman (1989) agrees with our determined ovarian cycle. Ovarian follicle diameters of females at Pope Co. A and Union Co. cave are similar to those of *E. l. melanopleura* from Arkansas (Ireland, 1974), but *E. l. melanopleura* oviposits from December through March. Future work including using histological techniques to determine if sperm storage occurs in the female spermathecae, should determine how long after insemination females deposit their ova and whether there is variation between time of insemination and subsequent oviposition.

Larval periods at Pope Co. A and B (McDowell, 1989) indicated a spring hatching of March and March/April respectively having unimodal distributions of monthly larval sizes. Differing year larvae were not present. Anderson and Martino (1966) also found larval hatchlings in March. Newly hatched larvae were not present at any other times at Pope Co. A, which correlates well with the estimated oviposition period of November through early January. However, larval hatchlings (those with yolk remnants) have also been found 15 February through 12 June at other sites in southern Illinois (McDowell, 1988; 1992; unpublished), which may indicate a spring ovipositional period. Tilley (1977) found adult female *Desmognathus ochropheus* with differing states of vitellogenesis (spent, with small ova, and with large yolky ova all within a monthly sample) and postulated an extended oviposition season. *Eurycea l. longicauda* may have a more lengthy and variable oviposition period than previously believed which warrants investigation of additional populations.



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## New Distributional Record for the Southern Leopard Frog in Frederick County, Maryland

Wayne G Hildebrand

A Southern Leopard Frog, *Rana sphenoccephala utricularia* (Crother, 2001), was found crossing Putman Road in Frederick County Maryland (N 39.52768°, W 077.44574) (about 16 mi. North Lily Pons) on 20 March 2003. The single specimen was photographed (Figure 1) and released at the capture site. Breeding choruses were heard on private land in this area during April 2002. The subsequent capture suggests a sustained population exists at this location. This occurrence extends the range (Harris, 1975) of *Rana sphenoccephala utricularia* west on to the Piedmont.



Figure 1. Southern Leopard Frog, *Rana sphenoccephala utricularia* (note the characteristic light spot on the tympanum)



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*News and Notes*Book Review

**Life-Histories of the Frogs of Okefinokee Swamp, Georgia. North American Salientia (Anura) No. 2**, by Albert Hazen Wright, 2002. xxi +509 pp. + 45 pls. Cornell University Press, Sage House, 512 E. State Street, Ithaca, NY. ISBN 0-8014-4046-7, Cloth \$49.95.

The original volume was first published in 1932 by the Macmillan Company, New York. It represents a classic among works in biology, and is unsurpassed in herpetology. Its original edition is extremely rare, and is only found in a few major libraries. I am honored to own an original autographed copy which I received from the author during my high school years, and to have the opportunity to reviewing the updated version. The present reprinted edition has been reprinted after 70 years and is provided with a splendid new forward and afterward by J. Whitfield Gibbons describing Wright's college years and associations with colleagues who accompanied Wright on the original Cornell Expeditions.

The author provides a highly enlightening review of previous studies on the amphibian fauna of the Okefinokee Swamp area, along with a discussion of the species known to inhabit the region, followed by a brief discussion of the life processes pertaining to his data provides. This is followed by a detailed life-history study for each of the 22 species of anurans inhabiting the region. Of the 22 species, *Scaphiopus holbrooki*, *Bufo quercicus*, *B. terrestris*, *Acris gryllus*, *Pseudacris nigrita*, *P. occidentalis*, *P. ocularis*, *Hyla andersonii*, *H. cinerea*, *H. femoralis*, *H. gratiosa*, *H. ornata*, *H. squirrella*, *H. versicolor*, *Rana clamitans*, *R. grylio*, *R. heckscheri*, *R. septentrionalis*, *R. sphenoccephala*, *R. virgatipes* and *Gastrophryne carolinensis*, only *Rana aesopus* has been relegated as a subspecies of *Rana capito*. The author provides information on the range, general appearance, measurements, habitat, first appearance, general habits, voice, mating, ovulation, eggs, hatching period, tadpoles, larval period, transformation of tadpoles, food, autumn disappearance, affinities, and lastly a bibliography for each of the species covered within the text for each of the 22 species under study. The plates provide black and white illustrations of amplexation, eggs, mature tadpoles, tadpole mouthparts, and transformed froglets. It is surprising that only three of the nomenclatural designations provided by Wright in his species account differ from present day nomenclature.

Any student of amphibology will certainly welcome the reprinting of this superb classic in the field of Herpetology. This well bound reprinting is reasonably

*News and Notes*

priced, and should be on the bookshelf of anyone interested in anuran biology, along with anyone interested in Herpetology or Natural History in general.

***Harlan D. Walley, Department of Biology, Northern Illinois University,  
DeKalb, Illinois 60115, email: hdw@niu.edu***

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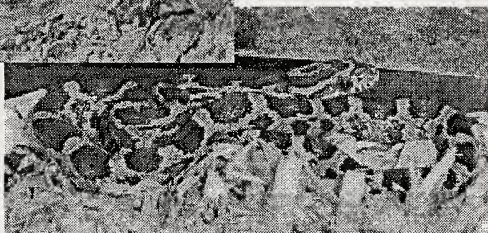
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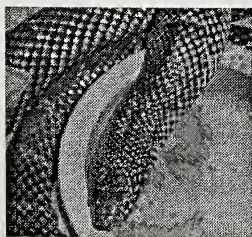


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# Herpetological Society

DEPARTMENT OF HERPETOLOGY

THE NATURAL HISTORY SOCIETY OF MARYLAND, INC.



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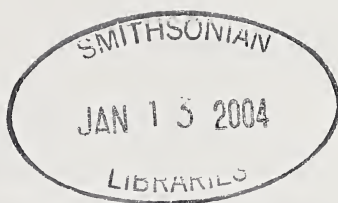
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# A NEW CRYPTIC SPECIES OF PSEUDOEURYCEA (AMPHIBIA, CAUDATA: PLETHODONTIDAE) OF THE LEPROSA GROUP FROM CENTRAL MEXICO

*Guillermo Lara-Góngora*

## ABSTRACT

A morphological and ecological well differentiated population of *Pseudoeurycea* belonging to the leprosa species group was collected at several localities in the central section of Eje Neovolcánico Transversal in central Mexico. It is named as a distinct species : *Pseudoeurycea tillicxitl*. A comparison of meristic, morphometric and coloration characters and ecological preferences is made with all the other recognized species of the leprosa group, and a more detailed analysis is made on the 2 known sympatric species with which it occurs, namely : *Pseudoeurycea leprosa* and *Pseudoeurycea altamontana*. *Pseudoeurycea tillicxitl* differs from *P. leprosa* as well as from *P. altamontana* in its lower number of maxillary - premaxillary teeth, and vomerine teeth, longer limbs, less webbing on hand and feet, coloration, body proportions, and ecological preferences. The status of *P. altamontana* is questioned.

## INTRODUCTION

In spite of the strong attention the Bolitoglossini tribe of plethodontid salamanders has received in the last 30 years (particularly the supergenus *Bolitoglossa*) knowledge on systematics and ecology of many neotropical salamander taxa is still partial or even unstable. See Brame (1968), Wake and Lynch (1976), Crump (1977), Maxson and Maxson (1979), Maxson and Wake (1981), Hanken (1983), Lynch, Wake and Yang (1983), Wake and Elias (1983), Papenfuss, Wake and Adler (1983), Elias (1984), among others.

Most of the interest and work done has been concentrated on tropical southern forms, and the accumulated knowledge on some more northern, boreal or transitional autochthonous groups is scarce, as it is true for several central Mexico highland species of the genus *Pseudoeurycea*. (For the most recent taxonomic review of the genus *Pseudoeurycea* and its status see Wake and Lynch, 1976.)

The leprosa group has not been a stable taxonomic entity since different authors do not agree on its species content (see Taylor, 1938, 1944 ; Wake and Lynch, 1976 ; Maxson and Wake, 1981; and Lynch, Wake and Yang, 1983). The 9 species recognized in this group by Wake and Lynch (1976) are distributed in boreal, mesic



forests, from above 2000 m asl. to tree line (except for *Pseudoeurycea nigromaculata*) in central and southern Mexico. Four species occur on the Eje Neovolcánico Transversal, 4 more occur in southern Sierra Madre Oriental, and 1 species occupies Sierra Madre del Sur. All of them but *P. leprosa* are microendemic and are known from only a few locations around their type locality.

Even though a diagnosis of the *leprosa* group has never been given, the group is generally characterized and distinguishable from other groups at the morphological level by having small to medium size species, with both hands and feet mainly unwebbed and having a dark brown background coloration, usually with light spots, bands or reticulations. A glandular circular area above the hind limb insertion is present in most species. The head is flat on its top, and the digits and toes are slender, tapering toward tip (except for *P. juarezi*, *P. nigromaculata* and *P. robertsi* in which are flattened.) Limb size is much variable, from short (*P. firscheni*, *P. leprosa*, *P. longicauda*, and *P. mystax*) to large or very large (*P. anitae* and *P. juarezi*). The number of maxillary and premaxillary teeth as well as vomerine teeth is also much variable, and goes from few teeth (*P. longicauda* and *P. robertsi*) to many (*P. firscheni*, *P. juarezi*, and *P. nigromaculata*). All species are terrestrial (semifossorial) but one is presumably somewhat troglodytic (*P. anitae*), and another one scansorial (*P. firscheni*).

*Pseudoeurycea leprosa* (Cope, 1869) is represented by large series in museum collections. It is an old and well known species, and the most abundant and wide ranging species of its group. Nevertheless, it has a very unstable taxonomic history as it is shown by the number of genera and species in which it has been placed. There are at least 9 different names to which this species has been allocated: *Spelerpes leprosus* (Cope, 1869), *S. laticeps* (Brocchi, 1883), *S. orizabensis* (Blatchley, 1893), *S. gibbicaudus* (Blatchley, 1893), *Oedipus leprosus* (Dunn, 1918), *O. cephalicus* (in part, Dunn, 1926), *O. orizabensis* (Taylor, 1938), *Bolitoglossa leprosa* (Taylor, 1941), and finally *Pseudoeurycea leprosa* (Taylor, 1944).

Smith and Smith (1976) correlated the above mentioned characteristics (high abundance, conspicuity, distinctiveness, and antiquity of knowledge) with a higher accumulation of synonyms for Mexican lizards. The same could be applied to this species, but also at least the following reasons may have contributed to the species unstable taxonomic history : 1) high geographical, ontogenic, and sexual variability within the species; 2) ambiguity and scarcity of good taxonomic parameters and criteria currently in use for this species; 3) Limited number of specimens studied in several of the old species descriptions; and 4) Absence of statistical treatment and data analysis.

Lynch, Wake and Yang (1983) found a great genetic variability in peripheral *Pseudoeurycea leprosa* populations. But because the high genetic variability and morphological overlapping they found, they didn't see fit to propose any taxonomic changes.

From a study on spatial resources partitioning by plethodontid salamanders at El Capulin region, in the state of Mexico (Lara and Ortega, 1980, unpublished) it was found that 4 species inhabited sympatrically the same area, among which there was a cryptic form of *Pseudoeurycea leprosa*, morphologically and ecologically distinct from it.

This study is concerned with the taxonomic description of this new species of the *leprosa* group, and its phylogenetic relationships with the other group members, with emphasis on *P. leprosa* and *P. altamontana* which are the other 2 sympatric species in the group.

### MATERIALS AND METHODS

Sixty eight specimens were checked, 44 belonging to *P. leprosa* and 14 belonging to the new taxon herein described. All specimens were or had been fixed in 10% formalin and preserved in 70% ethanol. Specimens are deposited in the 2 following collections: Museo Alfonso L. Herrera, Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFC), and Instituto de Biología, Universidad Nacional Autónoma de México (IBH), both in México city.

For the comparative analysis 57 parameters were taken into account:

**MERISTIC:** (4 parameters) maxillary-premaxillary teeth, vomerine teeth, separation of adpressed limbs, costal grooves.

**MORPHOMETRIC:** (28 parameters) snout to vent length (SVL), tail length (TL), snout to arm length (SAL), armpit-groin length (AGL), head width (HW), head length to gular fold (HLG), head length to quadratoyugal articulation (HLQ), foreleg length (FLL), hind leg length (HLL), eye diameter (ED), snout length (SL), interorbital width (IOW), internarial width (INW), eyelid width (EW), TL/SVL ratio, FLL/SVL ratio, HLL/SVL ratio, HLG/SVL ratio, HLQ/SVL ratio, SL/SVL ratio, AGL/SVL ratio, HW/SVL ratio, SAL/SVL ratio, ED/SVL ratio, IOW/SVL ratio, INW/SVL ratio, EW/SVL ratio, and separation of adpressed limbs/SVL ratio.

**COLORATION:** (6 parameters) maxillary-premaxillary teeth, dorsal body, ventral body, lateral body, tail, and limbs.



STATE CHARACTERS: (19 parameters) white lower eyelid, light parietal spots, digits and toes shape, hand webbing, feet webbing, digit formula, toe formula, first digit size, dorsal surface of body (texture), palate shape (arrangement of choanae and vomerine-parasphenoid series of teeth), nasolabial groove, cephalic dorsal musculature, digital pads, mental gland, dorsal head profile, lateral head profile, canthus rostralis, glandular area above insertion of hind limbs, and first transverse cephalic groove.

The criteria for the analysis of many of these parameters are those as Taylor (1938). All data were tabulated and 23 selected parameters were analyzed statistically using the chi-square, t-student, U-Mann-Whitney, and simple linear regression statistics, with a statistical significance of  $p=0.05$  for the null hypothesis. Null hypothesis was that *P. leprosa* and the new taxon described here belonged to the same population and represented the same taxonomic entity. For the remainder 34 parameters simple statistical concentration measures were calculated. Measurements and counts were obtained in a uniform manner. Measurements were taken with a dial caliper to the nearest 0.1 mm.

For additional comparisons with *Pseudoeurycea altamontana* and *P. leprosa*) I followed Taylor descriptions (1938.)

## RESULTS

From the statistical analysis of the 23 aforementioned parameters between *P. leprosa* and the new taxon hereby described, 11 proved to be of statistical significance at  $p=0.05$  thus rejecting the null hypothesis and supporting the distinctiveness of the new taxon and its taxonomic designation as a new species (refer to figure 1 for the parameters characterization.)

The 11 statistically significant parameters were: TL/SVL ratio, maxillary-premaxillary teeth number, vomerine teeth number, FL/SVL ratio, type of palate, separation of costal folds when the limbs are adpressed (ADP-LIMBS), maxillary-premaxillary teeth color, hand webbing, feet webbing, first digit size, and the decreasing sequence of toes size (toe formula.) (Refer to figure 3 for statistically significant parameters.)

The SVL comparison showed no statistical differences between *P. leprosa* and the new taxon, although the latter attains higher lengths than *P. leprosa*.

Linear regression analysis of individual characters as a function of SVL, particularly TL/SVL ratio, FL/SVL ratio, and ADP-LIMBS/SVL ratio, proved to be good discriminating parameters between the 2 taxa with almost no overlap in the FL/SVL



Figure 1. PARAMETERS CHARACTERIZATION  
Note. Type "A" palate is described in text.

Num.	PARAMETERS	Pseudoeurycea leprosa				Pseudoeurycea tillicxtil			
		RANGE	MEAN	S	REGRESSION EQUATION	RANGE	MEAN	S	REGRESSION EQUATION
1	SVL -TL Ratio	67.50 - 109.09	86.37	9.06	$Y = 9.04 + 0.6938X$	63.50-93.65	80.72	7.46	$Y = -4.85 + 0.9289X$
2	Max-Premax teeth	45-84	64.25	9.31		27-48	35.42	6.06	
3	Vomerine teeth	13-31	22.72	3.95		9-24	18.35	4.16	
4	FL-SVL	0.142-0.200	0.173	0.029	$Y = 3.383 + 0.207X$	0.193-0.318	0.227	0.029	$Y = 3.312 + 0.1516X$
5	Palate type		Variable (A=43.18%)			Constant (A=100%)			
6	Costal folds separation								
	(adpressed limbs)	2-5	3.51	0.62	$Y = 2.4444 + 0.277X$	-3.5 - +2	-0.26	1.36	$Y = -3.133 + 0.0638X$
7	Max-Premaxillary teeth coloration		Constant (RT=97.72%)			Variable (RT=42.85%)			
8	Hand webbing		Variable (Vestigial=4.65%)			Variable (Vestigial=57.16%)			
9	Foot webbing		Variable (Vestigial = 4.65%)			Constant (Vestigial = 100%)			
10	First digit size		Constant (Small=95.45%; vestigial=4.54%)			Constant (Small=14.28%; vestigial=85.72%)			
11	Toe formula (decreasing size)		Constant (34251=93.18%)			Variable (34251=64.29%)			

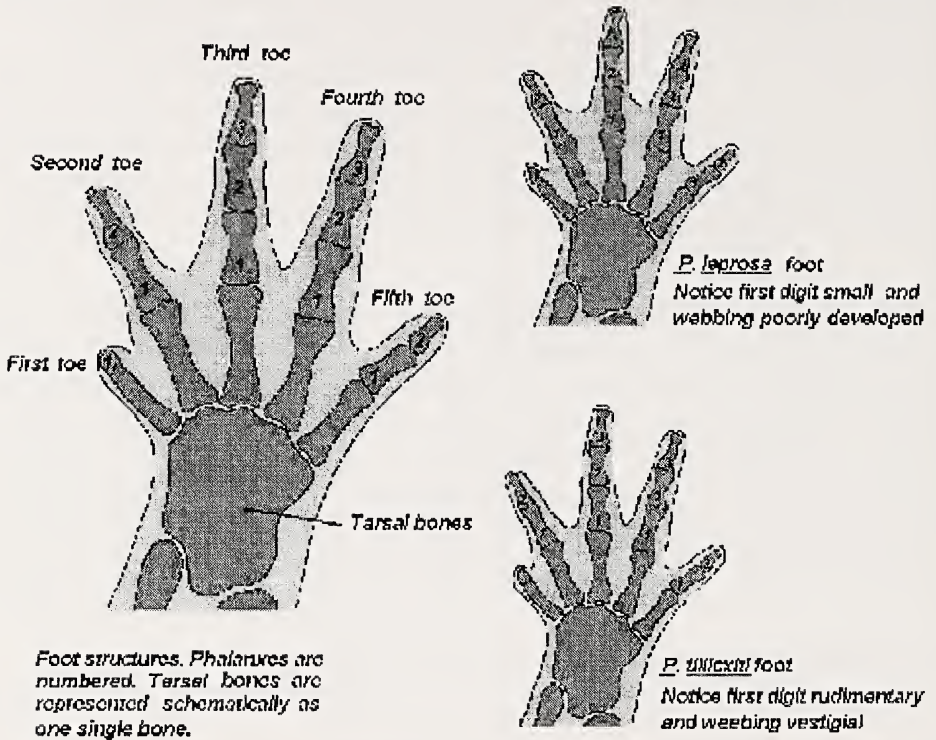


Figure 2. Schematic representation of foot structure and webbing in *P. leprosa* and *P. tillicxiti*

and ADP-LIMBS/SVL, which means that the new taxon has much longer feet than *P. leprosa* (see figures 5, 6 and 7.)

In regards with the palate type, the new taxon shows a constant arrangement of 2 series of vomerine teeth slightly curved and separated medially. The parasphenoid series are separated from the vomerine series by a distance approximately equal to the length of one vomerine series. The choanae are slit-like. In contrast, *P. leprosa* has a variable palate with choanae sometimes small and rounded and the vomerine series closer to each other.

Teeth coloration is constant in *P. leprosa*. The teeth are conspicuously red-tipped (RT), while in the new taxon they are variable in color, sometimes they are entirely transparent, but they are never conspicuously red-tipped.

Hand webbing is variable in both taxa but the new taxon has higher values for the vestigial character than *P. leprosa* (from base of first phalanx of second finger to base of first phalanx of third finger.)

PARAMETERS	NULE HYPOTHESIS	ALTERNATIVE HYPOTHESIS	STATISTIC	OBTAINED VALUES	STATISTICAL VALUES	p	CONCLUSION
1 (P. leprosa)	Ho: This sample comes from a normal population	Ha: This sample doesn't come from a normal population	Chi square	$X^2=18.75$	$X^2_{0.05},$ $32 = 46.194$	-	Ho: Accepted (Mistake Type II)
1 (P. ixtiltiltic)	Ho: This sample comes from a normal population	Ha: This sample doesn't come from a normal population	Chi square	$X^2=6.73$	$X^2_{0.05},$ $32 = 46.194$	-	Ho: Accepted (Mistake Type II)
SVL	Ho: $m < c$	Ha: $m > c$	t "student" (1 tail)	$t = -0.739$	$t_{0.05}$ $56 = 1.673$	-	Ho: Accepted (Mistake Type II)
MAX-PREMAX TEETH NUMBER	Ho: $m1 = m2$	Ha: $m1 = m2$	t "student" (2 tails)	$t = -17.80$	$t_{0.05}$ $56 = 2.003$	$p < 0.01$	Ho: Rejected (Mistake Type I)
VOMERINE TEETH NUMBER	Ho: $m1 = m2$	Ho: $m1 = m2$	t "student" (2 tails)	$t = -3.93$	$t_{0.05}$ $56 = 2.003$	$0.01 < p < 0.02$	Ho: Rejected (Mistake Type I)
PALATE TYPE	Ho: $m1 = m2$	Ho: $m1 = m2$	U Mann- Whitney	$z = -3.253$	$t_{0.05}$ $= 1.9600$	$0.001 < p < 0.002$	Ho: Rejected (Mistake Type I)
MAX-PREMAX TEETH COLOR	Ho: $m1 = m2$	Ho: $m1 = m2$	Chi square	$X^2 = 24.40$	$X^2_{0.05},$ $1 = 3.841$	$p < < 0.001$	Ho: Rejected (Mistake Type I)
HAND WEBBING	Ho: $m1 = m2$	Ho: $m1 = m2$	U Mann-Whitney	$z = -3.89$	$t_{0.05}$ $= 1.9600$	$p < 0.001$	Ho: Rejected (Mistake Type I)
FOOT WEBBING	Ho: $m1 = m2$	Ho: $m1 = m2$	U Mann-Whitney	$z = -5.35$	$t_{0.05}$ $= 1.9600$	$p < 0.001$	Ho: Rejected (Mistake Type I)
FIRST DIGIT	Ho: $m1 = m2$	Ho: $m1 = m2$	U Mann-Whitney	$z = -5.77$	$t_{0.05}$ $= 1.9600$	$p < 0.001$	Ho: Rejected (Mistake Type I)
TOE FORMULA	Ho: $m1 = m2$	Ho: $m1 = m2$	U Mann-Whitney	$z = -5.53$	$t_{0.05}$ $= 1.9600$	$p < 0.001$	Ho: Rejected (Mistake Type I)

Figure 3. Statistical characterization for those parameters with statistically significant values



Feet webbing is constantly vestigial in the new taxon (base of first phalanx of second toe to base of first phalanx of third and fourth toes) and variable in *P. leprosa*, but with low values for the vestigial character (see figure 2.)

First digit is small in *P. leprosa* as compared to vestigial (very small, with almost no free tip) in the new taxon. The decreasing sequence of toes size (toe formula) is constant in *P. leprosa*, but variable in the new taxon. In the latter third and fourth toes are sometimes of equal size (see figure 2)

Five additional parameters showed significant differences between *P. leprosa* and the new taxon. These parameters were 3 coloration characters: parietal spots, lateral coloration pattern and contrast between dorsal body and dorsal tail coloration, and 2 state characters: position of rictus oris in regards with the first transversal groove, and the postorbital groove. All parameters showed significant differences (= 90%) between both taxa (see figure 11.)

The parietal spot is almost always present in *P. leprosa* as a lighter area that can be creamish, pinkish or light brown. It is usually well evident. In the new taxon is always absent.

The lateral coloration pattern in *P. leprosa* can be described as typically consisting of a gray "sparkling" pattern of tiny round dots. It is located in the upper lateral area (laterodorsal) and it is markedly different from the lower lateral coloration (lateroventral) which is darker and without light dots. In the new taxon this pattern is always absent and the lateral coloration is the same as the dorsal one, consisting of individual or fused brownish spots or blotches.

The tail dorsal coloration is noticeably lighter than the body dorsal coloration in *P. leprosa*. It has more spots and light pigmentation. In the new taxon both coloration patterns are alike. The tail is not lighter or darker than the body or if lighter it is not conspicuously so.

The rictus oris is always separated from the first head transversal groove in *P. leprosa* (type A), while it is almost always in contact with the groove in the new taxon (type B) (See figure 12.)

The 2 sections of the postorbital groove (anterior and posterior) in *P. leprosa* form different angles. The anterior section has a greater angle and it is above the posterior section. On the other hand, in the new taxon both sections form a continuous and almost straight line (see figure 12.)

In accordance with data presented by Taylor (1938) an attempt was made to

analyze similarities and differences among the new taxon and *O. altamontanus* (=P. altamontana), *O. orizabensis* (=P. leprosa), and *O. leprosus* (=P. leprosa) based on their original descriptions. No attempt of statistical analysis was made because the reduced number of specimens of *O. altamontanus* and *O. leprosus*. For the same reason no variance analysis for the regression of characters was possible since  $F=0$ . Neither did the analysis was made for *O. orizabensis* because it has been widely recognized as a junior synonym of *P. leprosa* (Taylor, 1945, Smith and Taylor, 1948.) Therefore, only numerical trends were observed. To fit this purpose I transformed the real measurements given by Taylor to ratios and considered all characters as dependant or being a function of SVL in order to make possible a comparison of these 4 taxa (the new taxon, and *O. altamontanus*, *O. orizabensis* and *O. leprosus*.) These data are presented in figure 4. The number of specimens checked is too low to be conclusive. Although there are some evident and contrasting differences.

The new taxon has the lowest values for character 2, which means that its limbs insertions are closer to each other. This same taxon has intermediate values for character 6; i.e. it has longer hind limbs than *O. orizabensis* and *O. leprosus*, but smaller than those of *O. altamontanus*. The new taxon also differs from the latter in characters 8 and 10, having higher values and, thereby, longer snout (twice as long as that of *O. altamontanus*), and more separated nostrils. The new taxon differs from *O. orizabensis* in characters 1, 4, 5 and 3, and from *O. leprosus* in characters 5 and 3, thus having longer snout, head and forelegs, and a wider head.

*Pseudoeurycea tillicxiti* nov. sp.

(see figure 8)

The species epithet comes from 2 Nahuatl words (Nahuatl is one of the 2 most important native Mexican languages spoken today): *tiltic* = black, and *icxiti* = foot, in reference to the conspicuous “black feet” that typify this species.

Holotype.- MZFC-01461, adult male. Collected on July 13th, 1980 by José Antonio Hernández-Gómez and the author at 3 Km S of Laguna Quila, near Las Trancas mountain brook, in Parque Nacional Miguel Hidalgo (Lagunas de Cempoala), state of México. Elevation: 2950 m asl. It was found under a log, in a humid fir forest (*Abies religiosa*.) (see figure 9)

Paratypes.- MZFC-01461-2 from same date and locality. MZFC-01253 (2 specimens) from El Capulín, state of México. Collected on June 16th, 1979 by José Antonio Hernández-Gómez and the author, at an elevation of 3050 m asl in a pine forest (*Pinus hartwegii*.) MZFC-03985 to MZFC-03990 (6 specimens) from El Capulín area (Cerro Cadena, C. Pelado and C. Malacatepec). Collected in August 1980 by

Par.	PARAMETERS	<i>P. tlilicxitl</i>	<i>P. altamontana</i>	<i>P. leprosa*</i>	<i>P. leprosa</i>
1	Snout-arm / SVL ratio	0.295-0.355 X :0.321	0.308-0.352 X :0.330	0.268-0.368 X :0.286	0.256-0.334 X :0.293
2	Armpit-groin / SVL ratio	0.429-0.538 X : 0.490	0.555-0.575, X :0.565	0.503-0.600 X :0.540	0.417-0.600 X :0.542
3	Head width / SVL ratio	0.146-0.183 X :0.161	0.164-0.175 X :0.169	0.123-0.143 X :0.132	0.123-0.166 X :0.139
4	Head length / SVL ratio	0.170-0.290 X :0.199	0.209-.0212 X :0.210	0.144-0.172 X :0.166	0.147-0.204 X :0.169
5	Foreleg /SVL ratio	0.238-0.287 X :0.253	0.267-0.282 X :0.274	0.166-0.242 X :0.214	0.170-0.232 X :0.205
6	Hind leg / SVL ratio	0.193-0.295 X :0.269	0.300-0.341 X :0.320	0.191-0.253 X :0.222	0.142-0.200 X :0.173
7	Eye length / SVL ratio	0.037-0.077 X :0.051	0.061-0.065 X :0.063		0.032-0.050 X :0.041
8	Snout length / SVL ratio	0.101-0.158 X :0.138	0.050-0.57 X :0.053		0.085-0.153 X :0.128
9	Interorbital width /SVL ratio	0.038-0.077 X :0.054	0.045-0.047 X :0.046		0.036-0.054 X :0.044
10	Distance between nostrils/ SVL ratio	0.042-0.074 X :0.063	0.047-0.050 X :0.048		0.033-0.053 X :0.042
11	Snout-gular fold /SVL ratio	0.208-0.270 X :0.237	0.222-0.238 X :0.230		0.197-0.245 X :0.217
12	Eyelid width / SVL ratio	0.030-0.051 X :0.041	0.041-0.047 X :0.044		0.025-0.045 X :0.031
13	Tail length / SVL ratio	0.653-0.936 X :0.813	0.967	0.804-1.113 X :0.945	0.675-1.091 X :0.864
14	Maxillary-premaxillary teeth	27-48 X :35.4	55	64-73 X :68.5	45-84 X :64.2
15	Vomerine teeth	9-24 X :18.3	21	24-38 X :27.8	13-31 X :22.7
	n	14	2	9	44
	Source	Present study	Taylor (1938)	Taylor (1938)	Present study

Figure 4. Additional comparative data (body ratios) between *P. altamontana*, *P. leprosa* and *P. tlilicxitl*  
\* *P. leprosa* as a combination of values of *O. orizabensis* and *O. leprosus*



Juan José Ortega León and the author in pine forests (*Pinus leiophylla*; 4 specimens) and fir forest (*Abies religiosa*; 2 specimens) at 3000-3500 m asl. IBH-3683 from San Rafael, state of México. Collected on September 17th, 1977 by Gustavo Casas-Andreu and Aurelio Ramírez-Bautista. Elevation 2700 m asl; collected in a pine-oak forest. IBH-3683-2 from Western slope of Mountain Iztaccihuatl. Collected on September 17th, 1977 by Gustavo Casas-Andreu and Aurelio Ramírez-Bautista. IBH-3682 from Cerro La Cima, Distrito Federal; collected on June 3rd, 1979 by Fernando Cervántez-Reza. IBH-2715-3, from Desierto de Los Leones (Cruz Blanca), Distrito Federal. Collected on June 29th, 1979 by Zeferino Uribe-Peña (see figure 10)

### GEOGRAPHICAL RANGE

Central section of Eje Neovolcánico Transversal, at high elevations (above 3000 m asl) in Ocuilan, Ajusco, Las Cruces, and Sierra Nevada mountain ranges, in the states of México, Morelos and Distrito Federal (see figure 13), and very likely in western Puebla.

### DIAGNOSIS

A medium-sized species, SVL 30-64 mm,  $\bar{x}$  45.5 mm; maxillary-premaxillary teeth number (both sides) 27-48,  $\bar{x}$  35.4; maxillary-premaxillary teeth color: transparent: 57.15% or slightly red-tipped: 42.85%; prevomerine teeth number (both sides): 9-24,  $\bar{x}$  18.3; choanae slit-like: 100%; hand webbing poorly developed: 42.8% or vestigial: 57.16%, from the base of first phalanx of second finger to first phalanx of third finger; feet webbing vestigial: 100%, from the base of first phalanx of second to base of first phalanx of third to fourth toes; first finger rudimentary: 85.72% or small: 14.28%; toe formula (from biggest to smallest toe): 34251: 64.29% or third and fourth toe of equal size: 35.71%; TL/SVL ratio: 0.635-0.936,  $\bar{x}$  0.807; FL/SVL ratio: 0.193-0.318,  $\bar{x}$  0.227.

Black body coloration with numerous cream or brownish rounded or elongated spots, sometimes fused and forming a reticulated pattern all over the back and tail. Dorsal surfaces of arms and legs completely cream; hands and feet entirely black; ventral surfaces gray-black, sometimes with few, scattered and conspicuous light rounded spots (see figure 8.)

### DESCRIPTION OF HOLOTYPE

Head flat between orbits, but surface roughened, deeply pitted; snout rounded in dorsal profile; canthus rostralis rounded, but distinctive. A slight depression from anterior angle of eye toward nostril; nostril almost at tip of snout; distance between nostrils equal to interorbital width (1.9-1.9 mm). Width of eyelid slightly less than

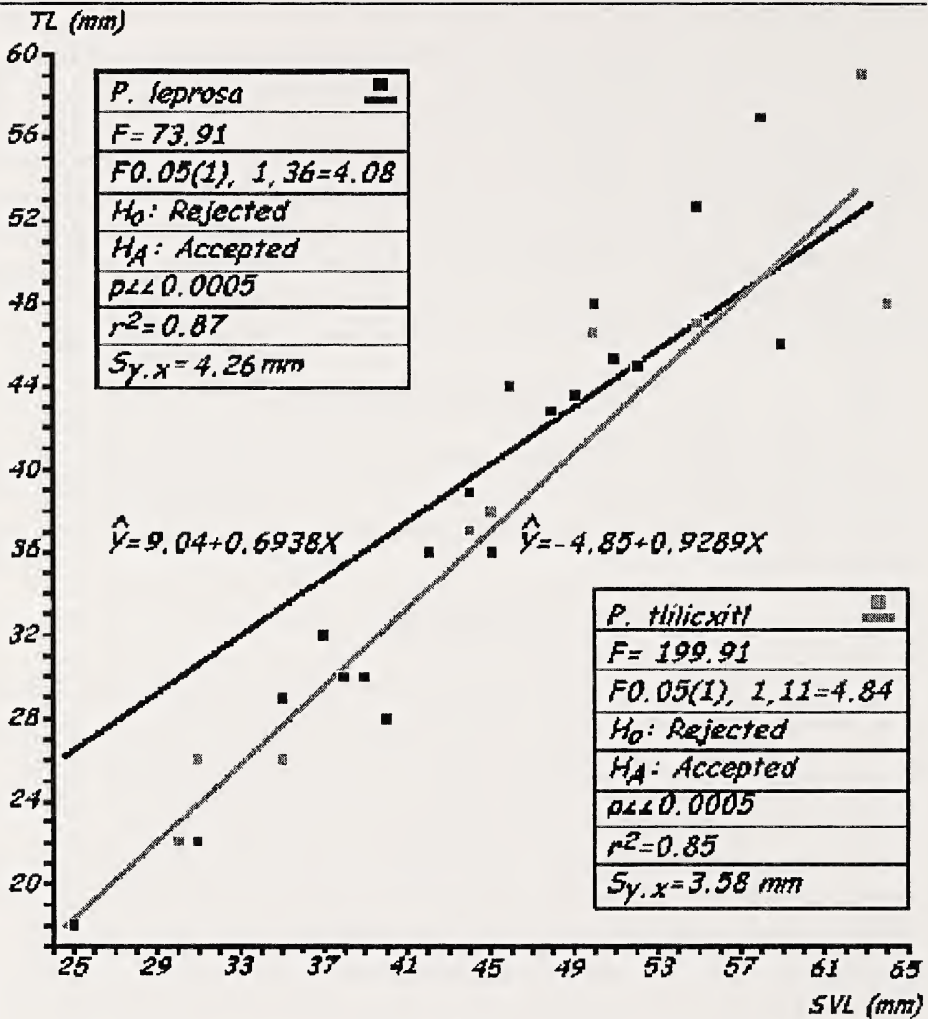


Figure 5. TL/SVL ratio linear regression. Comparison between  $b_1$  and  $b_2$ .  $H_0$ :  $b_1 = b_2$   
 $H_A$ :  $b_1 \neq b_2$  t “student” statistic.  $T = 9.25$ ,  $t_{0.05(2), 47} = 2.012$ .  $H_0$ =rejected,  $H_A$ =accepted.  
 $p < 0.001$ .  $H_0$ =values do not adjust to a line;  $H_A$ =values adjust to a line.  $r^2$ =proportion  
of total variation in “Y” explained by the regression (determination coefficient).  
 $S^2_{y.x}$ =variance of “Y” after taking into account dependence of “Y” over “X”.  $S_{y.x}$ =  
standard error of estimate or regression standard error.

interorbital distance (1.5 mm). Posterior ends of eyelids fitting under a fold. Length  
of eye bigger than its distance from tip of snout (2.8-2.0 mm). A deep longitudinal  
groove that runs from eye back to the end of gular fold, nearly straight (postocular  
groove as defined by Baird, 1951.) A transversal groove runs from a little behind

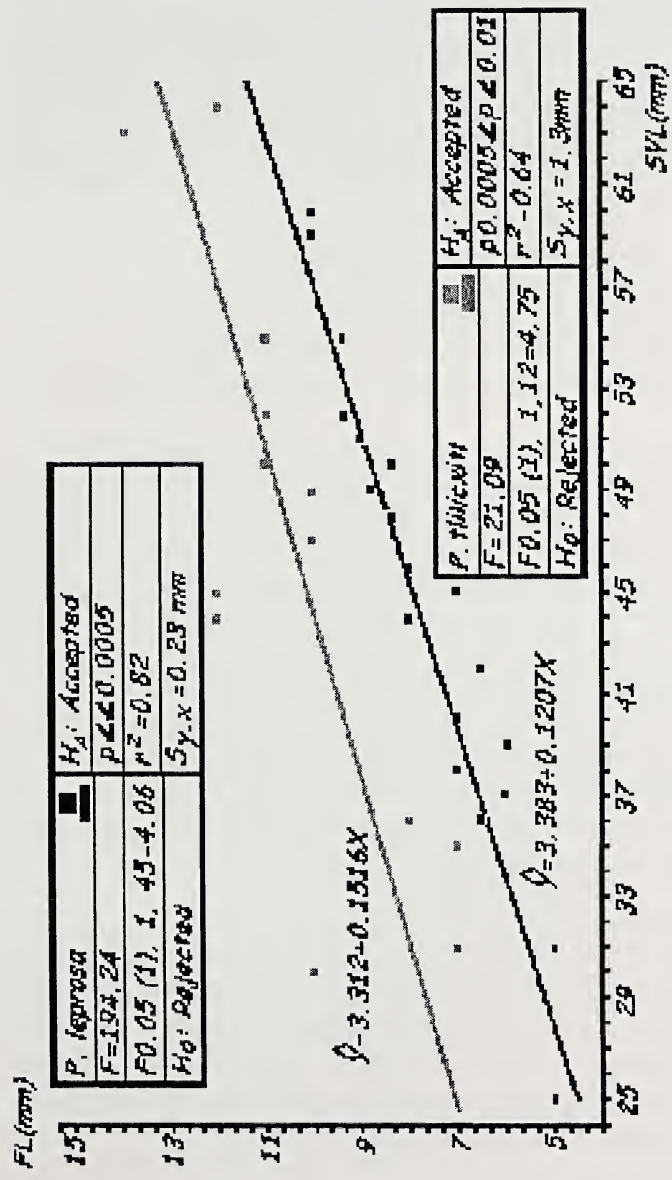


Figure 6. FL/SVL ratio linear regression. Comparison between  $b_1$  and  $b_2$ .  $H_0: b_1 = b_2$ .  $H_A: b_1 \neq b_2$ . "student" statistic.  $T=9.25$ ,  $t_{0.05(2,47)} = 2.012$ .  $H_0$ =rejected,  $H_A$ =accepted.  $p < 0.001$ .  $H_0$ =values do not adjust to a line;  $H_A$ =values adjust to a line.  $r^2$ =proportion of total variation in "Y" explained by the regression (determination coefficient).  $S^2_{y,x}$ =variance of "Y" after taking into account dependence of "Y" over "X".  $S_{y,x}$ =standard error of estimate or regression standard error.



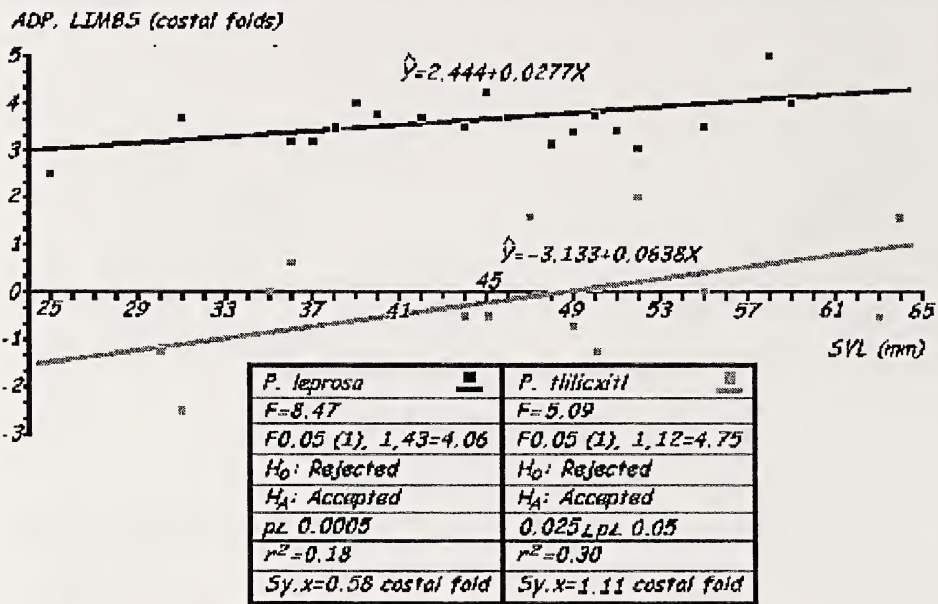


Figure 7. ADP.LIMBS/SVL ratio linear regression. Comparison between  $b_1$  and  $b_2$ .  
 $H_0$ :  $b_1 = b_2$   
 $H_A$ :  $b_1 \neq b_2$  t “student” statistic.  $T = 8.42$ ,  $t_{0.05(2), 56} = 2.003$ .  $H_0$ =rejected,  
 $H_A$ =accepted.  $p < 0.001$   $H_0$ =values do not adjust to a line;  $H_A$ =values adjust to a line.  $r^2$ =proportion of total variation in “Y” explained by the regression (determination coefficient).  $S^2_{Y.X}$ =variance of “Y” after taking into account dependence of “Y” over “X”.  $S_{Y.X}$ = standard error of estimate or regression standard error

rictus oris to dorsolateral portion of head, intersecting the longitudinal groove. Mentolabial gland indistinct.

Costal folds 12-12 (left-right); a deep medial dorsal groove that goes from posterior insertion of hind limbs to the transversal groove of head, where it bifurcates and runs toward eyelids. Ten costal grooves continue across venter; anal region very slightly swollen; interior of cloaca papillated.

Arms and legs elongated, separated by half a costal fold when the limbs are adpressed; a very slight indication of webbing; first finger extremely reduced (vestigial); the tip barely free; digital formula (from biggest to smallest): 3241; toe formula: 34251; webbing on hand from base of first phalanx of second finger to first phalanx of third and fourth finger. Webbing on feet vestigial, from base of first phalanx of second toe to base of first phalanx of third toe to first phalanx of fourth toe; tips of digits swollen underneath and tapering from base to tip.



Figure 8. Live specimen of *Pseudoeurycea tlilicxitl* from El Capulín, México. Photograph by José Antonio Hernández-Gómez

Skin of head and dorsal surface of body roughened and pitted; belly and limbs smooth; the belly with fine transversal grooves; hedonic gland not visible externally; no glandular area behind and above posterior insertion of hind limbs.

Vomerine teeth in 2 very slightly curved series of 9-10 teeth, separated medially and extending to the interior borders of choanae; palatine teeth in 2 series of 2-3 longitudinal rows, contiguous anteriorly, diverging and widening posteriorly, separated from the vomerine series by a distance approximately equal to the length of the vomerine series. Premaxillary teeth 6, small, curved, claw-like, and not piercing lip; 10-10 maxillary teeth; tongue boletoid, subcircular.

Length of snout 13.2 mm; armpit-groin length: 23.1 mm; head width: 7.2 mm; head length: 8.6 mm; foreleg length: 10.7 mm; hind leg length: 11.5 mm; eye diameter: 2.8 mm; snout length: 5.4 mm; interorbital width: 1.9 mm; distance between nostrils: 1.9 mm; snout to gular fold length: 10.7 mm; eyelid width: 1.8 mm; tail length: 37.2; SVL: 45 mm.

### COLORATION

(Preserved specimens) Body entirely black with cream to brownish spots, some or all fused to form a reticulated pattern all over the back and dorsal surfaces of tail and limbs. Head and feet entirely black without light markings or with few, small spots. This color contrasts sharply with light spots on upper portions of limbs. Ventral surfaces of body, tail and limbs are uniform gray black, sometimes with light rounded spots more conspicuous in throat and gular regions. Sides of body entirely black or with large light reticulation or spots.



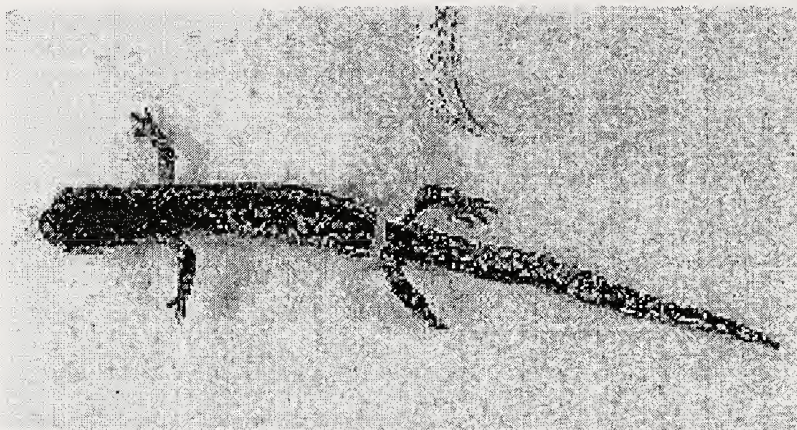


Figure 9. Holotype of *P. tlilicxtil*, MZFC-01461, adult male from Lagunas de Zempoala, México. Photograph by J. A. Hernández-Gómez



Figure 10. Comparison between *P. tlilicxtil* (2 specimens on the left) and *P. leprosa* (3 specimens on the right). Photograph by J. Antonio Hernández-Gómez



<i>Parameters</i>	<i>P. leprosa</i>	<i>P. tillicxiti</i>
Parietal spots	Lighter than surrounding areas; pinkish, creamish or brownish Present: 90.24% Absent (or not evident): 9.76%	Absent: 100%
Lateral coloration pattern	Upper (laterodorsal) and lower (lateroventral) areas well differentiated Upper consisting of a light gray “sparkling” pattern Lower same as ventral surfaces (darker and without light pigmentation) Present: 97.56% Absent or inconspicuous: 2.44%	Upper and lower sections alike. Pattern consisting of same dorsal coloration, with brownish individual or fused spots or blotches in a reticulated pattern, contrasting with uniform dark ventral surfaces 100%
Contrast between body dorsal coloration and tail dorsal coloration	Tail dorsal coloration contrastingly lighter than body dorsal surfaces In 92.5% of specimens No contrast in 7.5 %	No contrast between body dorsal coloration and tail dorsal coloration or if lighter not conspicuous 100%
Rictus oris	Always separated from first head transversal groove: 100% (type A) (see figure 12)	In contact with first head transversal groove: 80% or separated from it : 20% (type B) (see figure 12)
Postorbital groove	Anterior and posterior sections at different angles. Anterior section at higher position than posterior section, forming a broken line: 100% (type A) (see figure 12)	Anterior and posterior sections at the same angle and level, forming a continuous and almost straight line: 100% (type B) (see figure 12)

Figure 11. Additional significant coloration and state parameters between *P. leprosa* and *P. tillicxiti*.

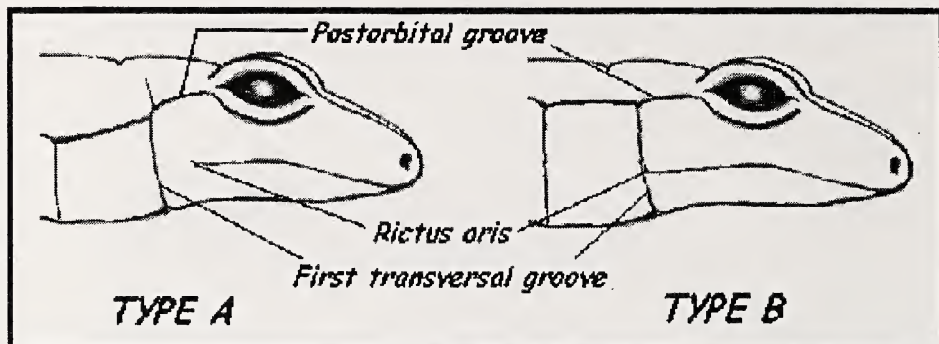


Fig. 12 Schematic representation of head lateral profiles as characterized by typical *P. leprosa* (type A) and *P. tillicxiti* (type B.) Notice main differences in terms of anterior-posterior sections of cephalic groove and rictus oris reaching or not the first transversal groove. Typical *P. leprosa* have 2 sections of postorbital groove at different angles, while typical *P. tillicxiti* have a continuous and almost straight line. Rictus oris is separated from the first transversal groove in *P. leprosa*, while it reaches and is in contact with the groove in *P. tillicxiti*.

### HABITAT AND HABITS

*P. tillicxiti* prefers open and somehow dry pine forests with bunchgrass as the herbaceous stratum. It can also be found in wetter environments coexisting microsympatrically with *P. leprosa* and *Chiropterotriton chiropterus*, in fir forests of *Abies religiosa*, and mixed temperate forests of *Pinus* spp., *Abies religiosa*, *Arbutus glandulosa*, *Alnus jorullensis* and *Quercus* spp., from 2700 m to 3500 m asl. It seems to prefer logs for microhabitat as hiding daylight shelters. One specimen was found under a soil mound and another under an extrusive volcanic rock.

*P. tillicxiti* is an uncommon species and it has a relative abundance much lower than its relative *P. leprosa*. A differential exploitation of forest macro and micro resources truly occurs between *P. tillicxiti* and the 3 other microsympatric species which it lives together with: *P. leprosa*, *P. cephalica* and *Chiropterotriton chiropterus*. No niche overlap occurs among them (Lara and Ortega, unpublished study.) Other amphibians and reptiles that occur within *P. tillicxiti* range are: *Crotalus triseriatus*, *C. transversus*, *Thamnophis scalaris*, *Storeria storerioides*, *Sceloporus mucronatus*, *S. palaciosi*, *S. anahuacus*, *S. aeneus*, *Barisia imbricata*, *Phrynosoma orbiculare*, *Pseudoeurycea cephalica*, *P. belli*, and *Chiropterotriton chiropterus*, among others.



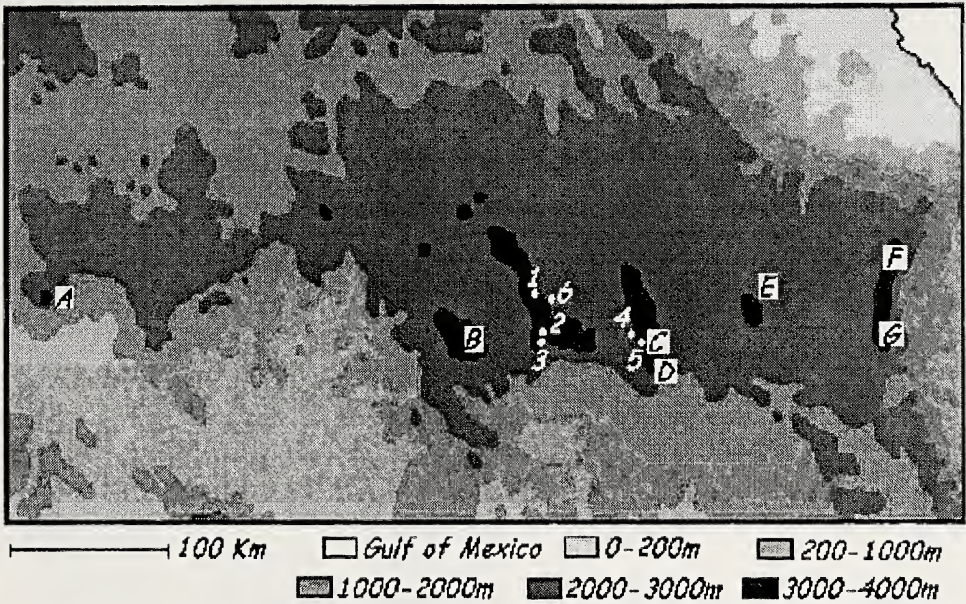


Figure 13. Geographical distribution of *P. tlilicxiti*. The map shows Eje Neovolcánico Transversal in central Mexico. Letters stand for highest mountain peaks: A= Cerro Tancítaro, Michoacán, B= Nevado de Toluca, México, C= Iztaccihuatl, México-Puebla, D= Popocatepetl, México-Puebla, E= Malinche, Tlaxcala-Puebla, F= Cofre de Perote, Veracruz, G= Pico de Orizaba, Veracruz. Numbers show *P. tlilicxiti* localities: 1= Cruz Blanca (Desierto de Los Leones), Distrito Federal, 2= El Capulín, México, 3= Lagunas de Zempoala, México, 4= San Rafael, México, 5= Western slope of Iztaccihuatl, México., 6= Cerro La Cima, Distrito Federal.

## DISCUSSION

The data analysis shows clear and conspicuous differences among *P. tlilicxiti* and all other species of the *leprosa* group (see figure 14), particularly as compared to *P. leprosa* itself, its assumed closer relative (see also figures 1-7 and 11-12.) Superficial similarities between *P. tlilicxiti* and *P. leprosa*, such as size, somehow similar coloration and sympatry (the “mimetic” character as “cryptic species”), has led many researchers to take *P. tlilicxiti* as “odd” *P. leprosa* specimens and include them both in the same jar labeled as “*P. leprosa*”, thus obscuring even more their real differences.

Since 1945, Taylor proved conspecificity of *Oedipus orizabensis* and *O. leprosus* with *P. leprosa*. This synonymy has remained unchallenged up to the present times even though the original descriptions of the types of these taxa seem to differ in some important respects. *S. leprosus* types (described by Dunn, 1926) have adressed toes either meeting or separated by 1 or 2 costal folds (as in *P. tlilicxiti*). *O. gibbicaudus*



	<i>P. altamontana</i>	<i>P. anitae</i>	<i>P. firscheni</i>	<i>P. tillichi</i>	<i>P. juarezi</i>
A. BODY SIZE (Max. SVL)	Small (48.6)	Small (50.0)	Medium (60.0)	Medium (64.0)	Small (50.0)
B. LEG SIZE	**Small (slightly larger than <i>P. longicauda</i> ) *Medium Large (touching)	Large (Touch or overlap 0.5)	Small (separated by slightly more than 2)	Large-very large (Slightly separated to overlap 3-5)	Large-very large (Slightly separated to overlap 2)
C. GLAND-ULAR AREA OVER HIND LEG	Present	?	Present	Present or Absent	Present
D. FOOT SIZE	?	Large (Larger than <i>P. mystax</i> )	Small (Half the size of <i>P. leprosa</i> )	Large	Medium (Slightly larger than <i>P. firschani</i> )
E. TOES & DIGITS	?	Short (But larger than <i>P. mystax</i> ); tapering toward tip	Long and slender (But flat, not tapering conspicuously toward tips)	Long and slender Tapering toward tips with well developed pads under tips	Short, broad and flattened, slightly expanded
F. WEBBING ON HANDS (ONLY ON THIRD DIGIT)	*Slightly webbed	Very slightly developed (distal end of first phalanx)	Slightly developed (to base of second phalanx)	Very slight to vestigial (distal end of first phalanx to its base)	Moderately developed (To base of first phalanx)
G. WEBBING ON FEET (ONLY THIRD TOE)	*Slightly webbed	Very slightly developed (distal end of first phalanx)	Moderately developed (to base of second phalanx)	Vestigial (to base of first phalanx)	Moderately developed (to base of second phalanx)
H. DIGITAL FORMULA (DECREASING SIZES)	F: 34251	H: 3241 F: 34251	H: 3241 F: 34251	H: 3241 F: 34251 OR 43251	H: 3241 F: 43521 OR 3=4
I. TAIL SIZE	Moderate (**X=0.820; *X=0.967)	Moderate (0.757-0.930, X=0.822)	Moderate (0.926, n=1 J)	Small to Moderate (0.835-0.938 X=0.807)	Moderate (0.949, n=1AF)
J. COSTAL GROOVES	12	13	14	12	?

Figure 14. Comparative data among species of *leprosa* group

<u><i>P. leprosa</i></u> Medium (63.0)	<u><i>P. longicauda</i></u> Medium (65.3)	<u><i>P. mystax</i></u> Small (47.5)	<u><i>P. nigromaculata</i></u> Small (56.5)	<u><i>P. robertsi</i></u> Small (57.0)	<u><i>P. tlahcuiloh</i></u> Medium (61.8)
Small (Smaller than in <i>P. longicauda</i> ; separated by 2-5)	Small (Separated)	Small (Separated by 2)	Medium (Separated by 1-1.5, but touching in juveniles)	Medium (Separated by 1 or touching in juveniles)	Medium
Present	Present	?	Present	?	?
Small (Smaller than <i>P. longicauda</i> ) Long and slender Tapering toward tip	? (Larger than in <i>P. leprosa</i> ) More or less slender but not long	Small (Stout) Short Tapering toward tip	? Broadly, flattened and truncated at tips. Digits very broad	? *Flattened, but at tips which are inflated and rounded	Large (?) (Apparently vestigial or slightly developed)
Very slight (To distal end of first phalanx)	Very slightly to vestigial (From distal end of third phalanx to its base)	Very slightly developed (To distal end of first phalanx)	Slightly developed (To distal end of first phalanx)	*Vestigial	(?) (Apparently vestigial or slightly developed)
Very slight (to distal end of first phalanx)	Very slight (to distal end of first phalanx)	Very slightly developed (To distal end of first phalanx)	Vestigial (to base of first phalanx)	*Vestigial	(?) (Apparently vestigial or slightly developed)
F: 34251	H: 3241 F: 34251 OR 43251	H: 3241 F: 34215	H: 3241 F: 34521 OR 43521	H: 3241 F: 34215	(?) Apparently H: 3241 F: 34251
Moderate (small to slightly large) (0.875-1.091, X=0.864) 12	Slightly large (X=0.980) 13	Small to moderate (0.642-785, X=0.718) ? Continuous over dorsum, projecting anteriorly at middorsum)	Large (1.500-1.289 X=1.232) 13	Moderate (**0.800) (*0.889-0.991, X=0.911) 13	Moderate to slightly large (0.810-1.030, X=0.950) ?

	<i>P. altamontana</i>	<i>P. anitae</i>	<i>P. firsiனி</i>	<i>P. tillicixtitl</i>	<i>P. juarezi</i>
K. MAX-PREMAX TEETH (ADULTS)	Moderate X=47	Moderate 59-85	Many 84-100	Few 27-48, X=35.42	Many 74-100
L. VOMERINE TEETH (ADULTS)	Moderate X=25 Series widely separated medially curving	Moderate 24-26 Short feebly curved series, perpendicular to median axis; widely separated	Many 32-42 Curved, barely separated	Few 9-24, X=18.5 Slightly curved series; separated medially	Moderate 24-30
M. DORSAL BODY COLORATION	BG: Dark (?) (Purplish-violet S: Light (Cream flecks and brownish-lavendar clouding)	BG: Moderately dark (Dark brown-reddish brown) S: Dark (2 series of dark irregular dorsolateral spots or bars)	BG: Moderately dark (Grayish or brownish-gray S: Dark (Few very small black rounded spots. Occasionally some light irregular spots may be present)	BG: Very dark (Black or very dark brown) S: Moderately light (Lighter than body; small, brownish and abundant but usually many of them fused to form a reticulation	BG: Moderately dark to dark (Light brown to blue-black) S: Light A light red or orange middorsal band
N. TAIL COLORATION	BG: ? S: ?	BG: ? S: Dark dorsal spots or bars	BG: Same as body (Tip of tail reddish-brown) S: Large, irregular few to moderately abundant light spots (Silvery-white to pinkish)	BG: Very dark (Black or very dark brown) S: Same as on body but lighter (Brownish to creamish and more extensive; more or less continuous over the tail as a band)	BG: Dark (Same as on body) S: Light (Same as on body but with more "black holes" on it; size and shape irregular)
O. VENTRAL SURFACES COLORATION	BG: Dark (Purplish-violet) S: Immaculate	BG: Light (Whitish) S: Nearly immaculate	BG: Moderately dark (Gray or blackish; a darker, ventrolateral band conspicuously separated lateral from ventral S: Light (Minute, whitish, abundant; even more under tail)	BG: Dark (Gray to black) S: Light (Only occasional rounded and light	BG: Light (Creamy-yellow) S: Dark (irregular spotting of dark pigment)

Figure 14. Continued



<u><i>P. leprosa</i></u>	<u><i>P. longicauda</i></u>	<u><i>P. mystax</i></u>	<u><i>P. nigromaculata</i></u>	<u><i>P. robertsi</i></u>	<u><i>P. tlahcuiloh</i></u>
Moderate	Few	Moderate	Many	*Few to **Very	Moderate
45-84, X=64.25	X=41	57-66	94-105	few *42-48 **X=28	46=58 X=43.6
Moderate	Few	Moderate	Moderate	Few	Moderate
12-31, X=22.72	X=19	Holotype=30	26-30	17	27
		Rows curved inward and backwards; scarcely separated	Long, curved backwards; scarcely separated	Curved series; separated	
BG: Very dark (Dark brown, slate or black) S: Lighter (Extensive irregular light brown to reddish-brown; many of them fused)	BG: Dark to very dark (Gray-brown to nearly black) S: Light A more or less indistinct (sometimes pale middorsal stripe)	BG: Moderately dark (Slate-gray) S: Dark (Small dark blotches in a more or less linear arrangement)	BG: Slightly dark to dark (Gray-black or dark lavender) S: Very dark (Black spots; some occasional silvery flecks on head)	BG: Light S: Darker (A well developed tan, red-brown or fawn middorsal veriegated stripe)	BG: Dark (black) S: Dark brown patches, and numerous tiny green flecks. Light areas on the occiput.
BG: Very dark (But often totally covered by spotting) S: Lighter (Same as on body but lighter; sometimes creamish or pinkish more extensive)	BG: Dark (Same as on body) S: Light (Same as on body but more extensive)	BG: Moderately dark (Same as on body) S: Light (Pale gray to white blotches on its sides)	BG: Light (Grayish-cream or pinkish-cream) S: Light (Light silvery flecks)	BG: Dark (Gray-black) S: Light (Same as on body or stripe broken into spots)	BG: Dark (Black) S: Dark brown blotches
BG: Dark (Gray-black) S: ?	BG: Slightly light to slightly dark (Pale gray to slaty) S: ?	BG: Very dark (Dark gray or almost black) S: Absent	BG: Light (Or lighter than dorsum) S: Light (Few light shades)	BG: Dark (Lead color) S: ?	BG: Dark

	<u>P. altamontana</u>	<u>P. anitae</u>	<u>P. firscheni</u>	<u>P. tillicxiti</u>	<u>P. juarezi</u>
P. CHIN- THROAT- ED COLOR- ATION	BG: Dark (Same as on venter) S: Light (Creamy flecks, not very conspicuous)	BG: Light (Whitish) S: Nearly immaculate	BG: Moderately light (At least lighter than venter; grayish) S: Light (Same as on venter but more numerous)	BG: Light (Lighter than ventral body surfaces) S: Absent	BG: Light (Same as on body ventral surfaces) S: Absent
Q. LATERAL BODY COLOR- ATION	BG: Light (Cream-lavendar) S: Immacute	BG: Light (Light gray) S: Absent	BG: Dark (Dark gray to almost black; "sparkling" pattern of minute silver-white dots) S: Dark (Few, if any; dark as on body)	BG: Very dark (Same as on body) S: Moderately light (Same as on body, at least on dorsolateral areas)	BG: Dark (Same as on body, at least posteriorly) S: ?
R. LIMBS COLOR- ATION	BG: Dark (Same as on body) S: Light (Creamy areas or spots on dorsal proximal parts; absent or less conspicuous on distal areas)	BG: Moderately dark (Brownish) S: Dark (Few)	BG: Moderately dark (Grayish as on body) S: Light (Large or one continuous area; pinkish or reddish-brown to cream; only on back of femora and humera conspicuous)	BG: Very dark (Same as on body) S: Light (Large, extensive only at front of femora and humera; absent on hands and feet; conspicuous)	BG: Dark (Same as on body) S: Light (As on body; merging with those on dorsum)
S. GEOGRA- PHICAL DISTRI- BUTION	Microendemic Central portion of Eje Neovolcánico Transversal MEX, MOR	Microendemic Sierra Madre del Sur OAX	Microendemic Southern tip of Sierra Madre Central VER, PUE	Microendemic Central Portion of Eje Neovolcánico Transversal DIF, MEX, MOR	Microendemic Southern tip of Sierra Madre Oriental in isolated Sierra de Juárez OAX
T. ALTI- TUDONAL DISTRI- BUTION (m asl)	3000 up	2100	2200-2600	2700-3500	2000-2500

Figure 14. Continued

<u><i>P. leprosa</i></u>	<u><i>P. longicauda</i></u>	<u><i>P. mystax</i></u>	<u><i>P. nigromaculata</i></u>	<u><i>P. robertsi</i></u>	<u><i>P. tlahcuiloh</i></u>
BG: Light (Or at least lighter than ventral body surfaces) S: ?	BG: Light (Or at least lighter than ventral body surfaces) S: ?	BG: Slightly light to slightly dark (Light gray to dark gray) S: ?	BG: ? S: With white silvery flecks	BG: ? S: ?	BG: Dark S: Few tiny lighter areas Gular fold bears a light edge
BG: Very dark (Brown, slate or black) S: Light (A "sparkling" pattern of minute rounded, very abundant, silver- white dots)	BG: Slightly light to slightly dark (Light gray to medium gray) S: Light (A "sparkling" pattern of minute, rounded, very abundant, silver- white dots)	BG: Moderately dark (Same as on body) S: Dark (As on body, costal grooves darker than folds)	BG: Dark S: Dark (Black spots)	BG: Dark (Brownish- lavender) S: Light (Orange-brown; few)	BG: Dark (Black) S: Light metallic brown
BG: Dark (Same as on body) S: Light (Few, if any; inconspicuous)	BG: Dark (Same as on dorsum) S: Light (Same as on body but small, few, and more or less indistint)	BG: ? S: Light (Mottled with light pink or light reddish- brown spots)	BG: Light or dark (Depending on body coloration) S: Present	BG: ? S: ?	BG: Dark (black) S: Small dark brown blotches (Digits light brown)
Endemic Central and Eastern portions of Eja Neovolcánico Tansversal DIF, MEX, MOR TLA, PUE, VER	Microendemic Central portion of Eja Neovolcánico Transversal in Sierra de Temascaltepec or Anganguao MEX, MICH	Microendemic Southern tip of Sierra Madre Oriental, in the Sierra de Villa Alta OAX	Microendemic Atlantic slope of Central Sierra Madre Oriental VER	Microendemic Central portion of Eja Neovolcánico Transversal in Nevado de Toluca MEX	Microendemic Central highlands of Sierra Madre del Sur GUE
2500-3600	2650-3000	2050	ca. 1000	3320-3600	2400-3000



	<u>P. altamontana</u>	<u>P. anitae</u>	<u>P. firscheni</u>	<u>P. tillicxiti</u>	<u>P. juarezi</u>
U. HABITAT	Pine & fir forests	?	Oak, pine and cloud forests	Pine, oak-pine, and fir forests	Clouds and pine forests
V. MICRO-HABITAT	Under logs	Under rocks	Epiphytic bromeliads	Under logs, rocks, or mounds of soil	Under bark of fallen trees or rocks
W. HABITS	Terrestrial (Semi-fossorial)	Presumably troglodytic	Scansorial (Arboreal)	Terrestrial (Semi-fossorial)	Terrestrial (Semi-fossorial)
X. SOURCES	*Taylor, 1938 (2)	Bogert, 1967 (3)	Shannon and Werler, 1955 (4);	This study (14)	Regal, 1966 (25)
AND VOUCHER	**Lynch et al, 1983 (not specified)		Regal, 1966 (2); this study (4)		
SPECIMENS (n)					

Figure 14. Continued

<u><i>P. leprosa</i></u>	<u><i>P. longicauda</i></u>	<u><i>P. mystax</i></u>	<u><i>P. nigromaculata</i></u>	<u><i>P. robertsi</i></u>	<u><i>P. tlahcuiloh</i></u>
Pine, pine-oak and fir forests	Pine, pine-oak, fir, and cloud forests	Pine and oak forests	Tropical evergreen and, maybe cloud forests	Pine forests	Pine-oak and mixed forests (pine-oak, fir, birch)
Under logs, bark of logs and stumps, or rocks	Under logs, wood chips, and bark of logs	Under rocks	?	Under stones	Under logs and under bark of standing trees
Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial	Terrestrial
(Semi-fossorial)	(Semi-fossorial)	(Semi-fossorial)		(Semi-fossorial)	(Semi-fossorial)
Lynch et al. 1983 (107); this study (44)	Lynch et al. 1983 (90); this study (5)	Bogert, 1987 (2)	Taylor, 1941 (33); Regal, 1986 (3); Shannon and Werler (not specified)	Taylor, 1938 (21); Taylor, 1944; **Lynch et al, 1983 (not specified)	Adler, 1966 (11)

(another synonym of *P. leprosa*) has adpressed toes separated by 4 costal folds (as in *P. leprosa*) while *O. orizabensis* types have the adpressed toes separated by 3 costal folds (as in *P. leprosa*) Even though *P. tillicxiti* can be clearly set apart from the types of junior synonym taxa of *P. leprosa* based on most of the body ratios presented previously, some differences among these types may lead us to think they are composite and represent more than one single taxon. The possibility of *P. tillicxiti* being included in those types series cannot be totally ruled out until a close examination of all type specimens be conducted (types are deposited in the collections of Kansas University.) However this does not challenge or compromise the taxonomic validity and distinctiveness of *P. tillicxiti* as described here.

In some morphological values, such as the low number of maxillary-premaxillary teeth, low number of vomerine teeth, big feet, and less webbing on toes, *P. altamontana* as referred by Taylor (1938), seems to show a close relationship to *P. tillicxiti*. For some other characters the latter seems to have intermediate values between *P. leprosa* and *P. altamontana*. *P. altamontana* and *P. tillicxiti* differ, among other characters, in several body ratios, vomerine teeth, and body coloration (see figure 4.) Specimens of *P. altamontana* in Mexican collections checked by myself have proven to be either *P. tillicxiti* or *P. leprosa*. In fact, it seems that there are no *P. altamontana* specimens in Mexican collections at all (!) In spite of extensive field work in *P. altamontana* type locality and presumable suitable habitat no specimens have ever been found. Even the "rare" microsympatric *Crotalus transversus* has been collected several times in the area. All this makes me tend to think that *P. altamontana* is either extremely rare or that it doesn't exist as a separate and distinctive taxon. US alcoholic specimens in museums seem to be scarce too and their allocation sometimes doubtful. Lynch, Wake and Yang (1983) reported *P. altamontana* specimens from "Zempoala district, 20 Km N of Tres Cumbres, Morelos". This locality is confusing because Lagunas de Zempoala are in the state of México, not Morelos, and the precise locality (20 Km N of Tres Cumbres) would lie in Cañada de Conteras formed by Magdalena stream, in Distrito Federal. Nevertheless they pinpointed the locality in their map on the southern slope of Sierra del Ajusco in the state of Morelos. For their locality 7 (in the text) they referred *P. leprosa* ("Zempoala district; 10 Km N of Tres Cumbres, Morelos) but in the map they showed *P. altamontana*. Later on, Lynch et al (ibid.) suggested that (I quote): "Because *P. altamontana* and *P. robertsi* are so similar genetically and are allopatrically distributed, a case should be made synonymizing them. However, because the species are distinct in color and body proportions we continue to recognize them as separate taxa to the present" (end of quote). So far I personally cannot say what *P. altamontana* really is, but *P. robertsi* is as different from *P. altamontana* original description as any other *Pseudoeurycea* spe-



cies is. Genetic similarity by itself doesn't prove conspecificity, let alone allopatry of populations. I am absolutely positive that nothing similar to *P. robertsi* occurs in the *P. altamontana* geographical range. I also can say that *P. tillicxidl* and *P. robertsi* are not the same, based on morphometric, meristic, coloration and ecological data (see figure 14.) But the real point here would be to show the controversial specific status of *P. altamontana*, as well as its geographical distribution.

Bogert (1967) related the character of long legs to scansorial habits. According to his statement, we could think of *P. altamontana* and *P. tillicxidl* as scansorial forms. But the fact that all specimens of both *P. altamontana* and *P. tillicxidl* have been collected on the ground (under logs) and the lack or scarcity of epiphytes in their habitat makes this view extremely unlikely, even though that it would explain the reduced number of specimens collected because of being looked for in the wrong microhabitat. The alternative explanation of possible extinction doesn't seem to be very likely but cannot be disregarded as impossible either. Habitat alteration has occurred in the type locality area that has affected drastically another microsimpatric salamander populations: *Rhyacosiredon zempoalensis*. Being microendemic, this species has been driven to the verge of extinction. Another possible explanation would be an extreme rareness of *P. altamontana* due to a very narrow range of tolerance to environmental parameters as it is the case of *P. tillicxidl*, but even with narrower ranges (being a truly stenoeccious specialist.)

Until a detailed analysis of the 2 known specimens of the type series of *P. altamontana* is made (they are at the University of Kansas) I recommend that the specific status of this salamander be considered as doubtful. Because of the herein proven distinctiveness of *P. tillicxidl* from *P. altamontana*, this stand would neither compromise nor challenge the validity of *P. tillicxidl*.

A final comment should be made about a recently described new *Pseudoeurycea* from Guerrero: *P. tlahuicloh* (Adler, 1996.) The author says that it superficially resembles *P. leprosa* in general proportions and color pattern. Besides the differences shown in figure 14 between *P. tlahuicloh* and all other *leprosa* group species, Adler adds that *P. tlahuicloh* has thinner and longer tail than *P. leprosa*, a larger head and a more pronounced neck. *P. tlahuicloh* differs from *P. tillicxidl* at least in having shorter legs, more premaxillary-maxillary teeth, more vomerine teeth, longer tail, and different coloration (dorsal, ventral, lateral tail and limbs). I wanted to include *P. tlahuicloh* within the *leprosa* group only because of its alleged resemblance to *P. leprosa*. Adler (op. cit.) didn't want to venture to allocate any of his 5 new species to any *Pseudoeurycea* group. The real kinship between *P. tlahuicloh* and other *Pseudoeurycea* species is still unknown.

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## Knobloch's King Snake (*Lampropeltis pyromelana knoblochi*) of Mexico a Species

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### Abstract.

Comparison of three *Lampropeltis p. pyromelana* with one *L. p. knoblochi*, all from Chihuahua, Mexico, indicates that the latter taxon is of species rank.

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A multi-redspotted king snake from western Chihuahua was described as *Lampropeltis knoblochi* by Taylor (1940). It continued to be so recognized at least until 1953 (Maldonado-Koerdell), although Bogert and Oliver (1945) suggested that it might be a subspecies of *Lampropeltis pyromelana* (Cope, 1867). The name last appeared at specific rank in Marx (1976), but that was in a list of type specimens, using the original name. In 1953 Tanner formally placed the taxon as a subspecies of *L. pyromelana*, and it has been so designated ever since.

The type locality was Mojárachic, Chihuahua, and Tanner (1985) noted specimens subsequently taken at Yóquiro and 25 mi S Creel, Chihuahua, and Yécora, Sonora. Campbell and Lamar (1989) recorded it from above Cascada de Baseachic, Río Durazno. Probably far more specimens have been taken for herpetohusbandry than have found their way into museums, to judge by the numerous (at least 21 to our knowledge) references on the subject (e.g., Assetto, 1984; Grumbeck, 1991; Markel, 1978, 1990; Mara, 1994; Martin, 1975). However, it is likely that some references are in error. Markel (1990), for instance, has a painting that is partially incorrect (the lateral blotches and sublateral light lines are not depicted, and the color is shown as red, rather than orange), and the two photographs supposedly of *L. knoblochi* are of *L. pyromelana*. The geographic ranges shown for the two species is also incorrect. Mara (1994) likewise illustrates *L. knoblochi* with a specimen actually of *L. pyromelana*. Much of the difficulty in such misidentifications is the absence of accurate locality data.

We here report another voucher specimen, UBIPRO 10575, taken by JALE at Arroyo del Agua, near Maguárichi (27°54'45.6"N, 107°58'49.2"W), at 2083 m, 25 September 2002. It is an adult female with the typical spotted pattern of the taxon (Fig. 1), measuring 776 mm TTL, TL 124 mm. The ventrals are 228, anal entire, subcaudals 66 (missing a few terminal scales), scale rows 23-25-19. There are 7-7 supralabials, 8-9 infralabials, 1-1 preoculars, 1-1 loreal, 2-2 postoculars, temporals 1-1 although a second one is narrowly separated from the postoculars.



Figure 1. Dorsal view of *Lampropeltis knoblochi*, UBIPRO 10575.



Figure 2. Ventral view of same specimen as in Fig. 1.



Dorsal orange spots on body 38 (or 48 if fused ones are counted separately); 15 spots on tail, all but the terminal three orange-centered; spots on body black-bordered, 8-11 scale rows wide, 2-5 (usually 3-4) scales long, bordered laterally by an irregular white line 1 scale wide, and separated by white interspaces 1 scale long.

A series of rounded, orange, extensively fused, black-bordered spots, 2-3 scales in diameter, lateral to lateral light line; an irregular sublateral light line ventral to the lateral spots, mostly along the 1st and 2nd scale rows. Ends of more or less alternate ventrals orange; scattered, more or less square black spots, about one ventral in length, scattered on venter (Fig. 2).

Snout light tan; a roughly doughnut-shaped, black-bordered orange spot on head, frontal to parietals, extending to lower eye level, and surrounding a light central spot on posterior tip of frontal; a light tan ring, the first of the interspaces between the spots on body, crossing the posterior ends of the parietals; anterior black border of 1st dorsal spot extending laterally no farther than the level of the 7th supralabial, and posterior to it; no markings on either supralabials or infralabials.

This specimen is sharply different from *L. p. pyromelana*, of which three adults were collected by JALE and Matthew J. Ingrassi in the summer of 2002. They are UBIPRO 10172 from km 38 on the Chihuahua-Namiquipa highway (29°4'38.3"N, 106°36'30.4"W), 2300 m, 9 August; UBIPRO 10190, km 17.1, Chihuahua-Namiquipa highway (29°5'28.7"N, 106°28'51.4"W), 1743m, 9 August; UBIPRO 10955, middle of Cañon del Oso (31°16'17.7"N, 108°43'7.0"W), 1661m, 18 September. The head scales in these specimens are the same as in *L. p. knoblochi*, except that the anterior temporals are 2-2 in two, 1-1 in one. The ventrals are 217-225, subcaudals 70-72 (all males); scale rows 23-23-19 in two, 23-23-17 in one. The dorsal spots are bright red, black-bordered and open-sided, the red portion extending across the abdomen or well onto the sides of the ventrals. The light interspaces between the dorsal spots number 38, 43, 43, on tail 9, 10, and 16 (counting the anal interspaces). The black spots on the ventrals tend to be more rectangular than square, in numerous cases extending across much or all of the scales. The dorsal blotch on head is jet black, not light-centered; there are one or two black streaks on infralabial sutures; the anterior black border of the first body ring reaches to or ventral to the 7th supralabial, bordering or crossing it. The largest specimen measured 963 mm TTL.

Although no differences in scutellation of these two subspecies are evident, there are numerous differences in color and pattern. *L. p. knoblochi* differs from *L. p. pyromelana* in having orange (*vs* red) markings on body; dorsal markings spotlike (*vs* ringlike), a lateral light line (*vs* none); a row of small, orange, black-bordered spots below the lateral light line (*vs* none); a sublateral light line below the lateral

spots (vs none); orange on ends of ventral scales independent of more dorsal spots (vs connected, and more extensive); and dorsal blotch on head doughnut shaped, orange-centered, enclosing a tan central dot (vs wholly jet black).

These distinctions appear to be categorical. Tanner (1953) regarded two specimens, from northern Sonora and southeastern Chihuahua as intergrades, but they are far from the range of *L. p. knoblochi*, and later were apparently assumed to be variants of *L. p. pyromelana* by Tanner (1983, 1985).

Furthermore, the range of *L. p. knoblochi* appears to be dichopatric relative to the range of the other subspecies. It is limited to the spectacularly deep canyons on Pacific slopes of extreme southwestern Chihuahua, whereas *L. p. pyromelana* is limited to the Atlantic slopes of the Sierra Madre, except perhaps in the extreme north.

For these reason, we revive the rank originally assigned to *L. knoblochi* (Taylor, 1940). It is obviously related to *L. pyromelana*, but appears to be on an independent evolutionary tangent.

### Acknowledgments.

We are much indebted to Dr. E. A. Liner for help with the literature, to Matthew J. Ingrassi for field assistance and to Dr. Ned Friedman and William Gallup for the photographs. CONABIO kindly provided support for field work by JLE under projects U003, X004 and AE003.

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## Dislributional and Variational Data on the Frogs of the Genus *Rana* in Chihuahua, Mexico, Including a New Species

Hobart M. Smith and David Chiszar

### Abstract.

Seven species of *Rana* are known to occur in Chihuahua: *R. berlandieri*, *R. catesbeiana*, *R. chiricahuensis*, *R. forreri*, *R. magnaocularis*, *R. lemosespinali* sp. nov., and *R. tarahumarae*. Locality and variational data on these species are recorded from material of the genus recently collected in the state by Julio A. Lemos-Espinal.

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Material of the genus *Rana* collected in recent years by Julio A. Lemos-Espinal (JLE) include representatives of all but one of the known species of that genus in the state, as well as a new species. Material reported here for the first time is in the collection of Unidad de Biología, Tecnología y Prototipos (UBIPRO), Facultad de Estudios Superiores Iztacala, Tlalnepantla, México. All catalog numbers refer to that collection.

### *Rana berlandieri* Baird

Current knowledge of distribution of this species in Chihuahua, as represented by Conant and Collins (1998) indicates restriction to the eastern half of the state. The present material confirms its existence also in the southwestern mountains. Specimens at hand include 6962-70, Ojo Rancho del Cuervo (30°14'29.5"N, 105°19'52.1"W), 1134m; 6676, 6825, Ejido Mesa El Zorrillito, Guadalupe y Calvo (26°3'34.8"N, 106°57'28.8"W), 2595m; 8079, Río Papigochi at La Junta, mpio Guerrero (28°27'54.0"N, 107°19'39.4"W), 2103m; 8525, Basigochi de Aboreachi, mpio Guachochi (27°5'26.3"N, 107°14'40.3"W), 2400m; 8531-3, 8537-40, Guazárare, mpio Guachochi (27°3'47.2"N, 107°12'0.5"W), 2300m; 8025, river 1 km W Balneario División del Norte, mpio Jiménez (25°53'32.8"N, 104°22'17.8"W), 1360m; 9133-4, km 209.5 Creel-Guachochi (27°5'23.1"N, 107°14'59"W), 2350 m. Webb and Baker (1984) reported (as "*Rana pipiens* group") what is presumably the same as the western Chihuahua *R. berlandieri* here reported, from 7.7 rd mi SW El Vergel, 3002m, and 15 rd mi NE Atascaderos, 2900 m, in Chihuahua; others were reported from adjacent Durango.

The western samples probably represent a taxon different from that of the eastern sample; the two populations appear to be dichopatric. The eastern samples al-

ways have considerable dark pigmentation on the lower jaw, at least at the sides, and the rear surfaces of the thighs are boldly reticulated, black on white. In the western samples, with one exception, there is little or no pigmentation on the lower jaw, and the rear surfaces of the thighs are not at all, or but weakly, reticulated. The exception is a transformling 28mm SVL from La Junta. Nos. 9133-4 are partially transformed tadpoles 78-82 mm TTL, tail 50-52 mm, hind leg length 29-39 mm, no forelegs. The tail is mottled black.

In all samples, the dorsolateral folds often are not noticeably displaced posteriorly. No. 6825 is a male with external vocal sacs, associated with a clutch of eggs.

***Rana catesbeiana* Shaw**

Lemos-Espinal *et al.* (2000) reported this species (UBIPRO 2169) from Ejido Ojo de Enmedio, at the base of the Sierra de Samalayuca.

***Rana chiricahuensis* Platz and Meham**

The range of this species slightly overlaps that of *R. berlandieri*: 8495-7, Basigochi de Aboreachi, mpio Guachochi (27°12'12.2"N, 107°22'45.0"W), 2409 m; 10380, km 95, Flores Magón-Buenaventura (29°54'12.9"N, 107°17'49.1"W), 1591 m; 8854-5, tadpoles, Pacheco (30°5'1.7"N, 108°20'29.4"W). It is our opinion that the "*Rana sinaloae*" (= *Rana pustulosa*) of Domínguez *et al.* (1977) is actually *Rana chiricahuensis*; it is from 13 km W Matáchic; the latter is at 28°51'N, 107°45'W.

The series of four adults varies in SVL 45-52 mm. The most striking characteristic shared by all four, and differing from all other species of *Rana* in the state, is the nearly or quite uniformly dark posterior surfaces of the thighs, except for a tiny white dot capping each of the numerous tubercles.

The dorsolateral folds are bright white in two, dull-colored in two; they are not noticeably displaced posteriorly. The upper lip is prominently reticulated black and white in three, only marginally in one. The prominent subtympenic white stripe ends anteriorly below the eye. There are 11-17 dark spots between the dorsolateral folds, one on each eyelid. In only one is there a dark spot anterior to the anterior border of the eyes.

The two tadpoles are unusual in having the musculature of the tail and dorsum of the body prominently evident, whitish in color. The whitish epaxial muscles extend anteriorly almost to the eyes, and sharply contract with the dark skin elsewhere.



*Rana forreri* Boulenger

This species was reported for the first time from Chihuahua by Lemos-Espinal *et al.* (2002), UBIPRO 5923, at Arroyo El Camuchil, Batopilas (27°01'34.1"N, 107°45'44.5"W), 435 m, 17 July 2000. The present collection includes UBIPRO 9025 (tadpoles) and 9398 from the same locality, coordinates and altitude as the preceding; and 10605-6, Arroyo Las Borregas, Chínipas (17°23'4.3"N, 108°32'21.1"W), 470 m.

The transformed specimens available are 59, 48 and 27 mm SVL; the posterior surfaces of the thighs are very dimly or not reticulated; the dorsolateral folds are dull-colored, embrace 10 or 11 large dark spots, and are not noticeably displaced posteriorly.

There are about 35 tadpoles under no. 9025; their assignment to *R. forreri* is conjectural. The breeding seasons of the sympatric *R. forreri* and *R. magnaocularis* are thought to be different (Frost and Bagnara, 1977); and the specimens obtained of the latter species are all transformed, whereas the tadpoles available are quite small.

Regardless, the tadpoles (about 35) are unusual in their small size (11.5 mm maximum body length), opaquely black body, and the presence of 7 mm hind legs on the largest specimens. The tail fin at midtail is little more than half the diameter of the tail musculature at that point. There are two equally long rows of denticles in the upper labium, but the inner row is widely split about half the length of either end. The lower labium has three complete rows of equal length of denticles,

*Rana magnaocularis* Frost and Bagnara

This species is partially sympatric with *R. ferreiri*, and appears to be much more abundant. It has not been reported before from Chihuahua, although known localities of occurrence are very close. Available are 9244, 9427-34, Arroyo El Camuchil, Batopilas (27°01'34.1"N, 107°45'44.5"W), 435 m; 9069-70, 9294-9316, 9336-8, 9440, Batopilas, same coordinates and altitude as the preceding; 10607, Arroyo Las Borregas, Chínipas (17°23'4.3"N, 108°32'21.1"W), 470 m.

All specimens available are juveniles; the maximum SVL is 46 mm, and the smallest is a transformling with a tail remnant 7 mm in length, and the SVL is 26 mm. The dorsolateral folds are white except in the smallest specimens, in which they are dull-colored. The posterior surfaces of the thighs are brightly mottled. Dorsal dark spots are not evident in the transformling; apparently further development is required before their appearance is triggered, because fully transformed individuals of the same size as the transformling have well-developed spots.

The dark spots between the dorsolateral folds, anterior to the end of the urostyle but excluding the head, vary 11-21 ( $M=16.7$ ). The dorsal cranial dark spots vary considerably, but never number more than three (only one has that number). Occasionally (20% of 24 in which spots are reliably discerned) there are no spots on top of the head at all.

The displacement of the dorsolateral folds posteriorly is regularly evident.

*Rana lemosespinali* sp. nov.

Holotype. LE-UBIPRO 8236, adult male, between Creel and San Rafael, municipio Urique (27°31'18.2"N, 107°50'50.5"W), 2313 m, 8 September 2001, Julio A. Lemos-Espinal collector. *Paratypes*. Seven topotypes, LE-UBIPRO 8233-5, 8237-40. *Referred material*. LE-UBIPRO 9495, 1 km N Humira (27°25'43"N, 107°29'24.6"W), 1900 m, 13 July 2002.

*Diagnosis*. A member of the *Rana pipiens* group having 25-46 sharply outlined, white-bordered dark spots between the dorsolateral folds; dorsolateral fold prominent and continuous; dorsum weakly ridged as well as pustular; sides of body strongly granular; venter unpigmented.

*Description of holotype*. Male, 54mm SVL; 46 light-bordered dark spots between dorsolateral folds from behind eyes to near the end of the urostyle, tending to be elongate; a weak longitudinal ridge in the center of some spots; dorsal skin somewhat pustular, not smooth; dorsolateral fold light tan, not white, continuous to rear level of urostyle, curving slightly medially over sacrum; sides of body strongly granular, upper parts with numerous dark spots like those on dorsum, lower parts whitish, black-reticulated; venter white, unpigmented, granular posteriorly.

Two small dark spots on each eyelid, two between and two on snout; a bright white stripe from axillary level to below eye, indistinguishable anteriorly; upper lip black-reticulated on white, trending longitudinally; a few black spots posteriorly on lower lip.

Posterior surfaces of thighs granular on lower third, smooth on upper part, reticulated black on white; dark crossbars on hind legs distinctly narrower than spaces between.

*Variation*. The paratypes are remarkably similar to the holotype. They vary 53-56 mm SVL; 1-2 dark spots on snout, anterior to orbits; 2-4 small supraorbital spots (total both sides); 1-3 spots between orbits; interdorsolateral fold spots 28-46 ( $M=37$ ).



The referred specimen from near Humira is somewhat different from the type series, having but 25 interdorsolateral fold spots, and the dark crossbars on hind legs equal in width or wider than their interspaces. The locality is about 40 km east of the type locality, and both are on Pacific slopes.

**Comparisons.** All of the other six species of *Rana* known from Chihuahua are readily distinguished from *R. lemosespinali* by having fewer than 25, or no, dorsal spots. Other conspicuous differences occur in *R. catesbeiana* and *R. tarahumarae*, both lacking well-defined dorsolateral folds (vs present) and no spotting about (vs spotted); *R. chiricahuensis* has a uniformly dark, white dotted posterior surface of thigh (vs reticulated) and a dark-pigmented ventral surface (vs white); *R. berlandieri*, *R. forreri* and *R. magnaocularis* all have smooth sides of the body (vs granular).

*R. chiricahuensis* appears to be most similar to *R. lemosespinali*, sharing size, granular skin, weak ridges on the dorsum, etc. The two may be dichopatric in Chihuahua, the latter to the west of the Continental Divide, the former to the east.

**Etymology.** The species is named for the collector, Dr. Julio A. Lemos-Espinal, who has studied and sampled the herpetofauna of the previously rather neglected state of Chihuahua far more than anyone else.

### ***Rana tarahumarae* Boulenger**

Although this species is well known from the same area in which *R. lemosespinali* was taken (Tanner, 1989; Zweifel, 1968; other records in Domínguez *et al.*, 1977; Webb and Baker, 1984; Webb, 2000), JLE has not found it, perhaps because of its specialized, highly aquatic habitat. It is likewise surprising that no others have collected *R. lemosespinali* where JLE found it.

This species is almost twice the size of *R. chiricahuensis* and *R. lemosespinali*, and is readily distinguished from all other species of *Rana* in Chihuahua, except *R. catesbeiana*, by the absence of or very weak dorsolateral folds. The latter species is readily distinguished from the former by its larger, smooth-surfaced tympanum, nearly as long as eye or longer, and its very large size, maximum 203 mm (vs a tubercular tympanum about half as long as eye, and a SVL not exceeding about 102 mm). *R. catesbeiana* does not occur in the mountainous habitat of the *R. tarahumarae*.

The records for *R. tarahumarae* in Chihuahua and adjacent Sonora are all in the southern corners of the states, widely isolated from the records in the United States and northern Sonora. Electrophoretic comparisons would be of considerable interest.



### Key to the Species of *Rana* in Chihuahua

Because of the frequently encountered difficulty of determining whether the posterior ends of the dorsolateral folds are displaced or not, despite frequent use in keys, we here mostly resort to other characters that we regard are more readily determined.

- 1A. Dorsolateral folds absent or dimly evident ..... 2
- B. Dorsolateral folds clearly evident ..... 3
- 2A. Diameter of tympanum about half that of eye; SVL not exceeding ~102MM ..... *tarahumarae*
- B. Diameter of tympanum about equal to eye diameter, or (in males) much greater; SVL to 203 mm ..... *catesbeiana*
- 3A. Posterior surfaces of thighs more or less uniformly dark except for a tiny white dot on each of the numerous, small tubercles ..... *chiricahuensis*
- B. Posterior surfaces of thighs patterned differently ..... 4
- 4A. Dark spots between dorsolateral folds 25 or more; sides of body strongly granular ..... *lemosespinali*
- B. Dark spots between dorsolateral folds 23 or fewer; sides of body smooth ..... 5
- 5A. Southwestern corner of the state, at altitudes less than 500m ..... 6
- B. East of the continental divide, at altitudes greater than 1000m ..... *berlandieri*
- 6A. Posterior surfaces of thighs not or very dimly reticulated; dark dark spots between dorsolateral folds fewer (10-11 in available material); dorsolateral folds not displaced posteriorly ..... *forreri*
- B. Posterior surfaces of thighs strongly reticulated; dark spots between dorsolateral folds more numerous (11-21, M=16.7); dorsolateral folds usually clearly displaced posteriorly ..... *magnocularis*

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We are grateful to Robert G. Webb for critical counsel.

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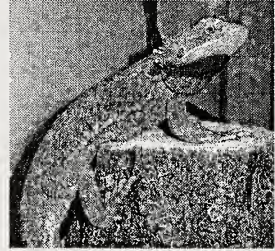




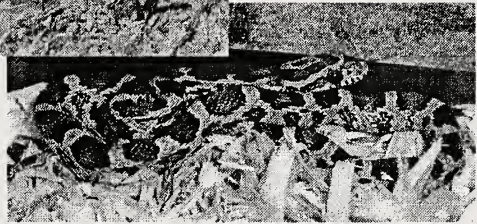
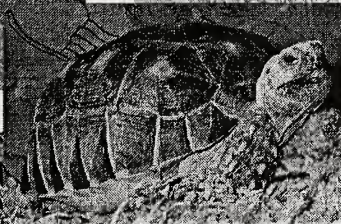
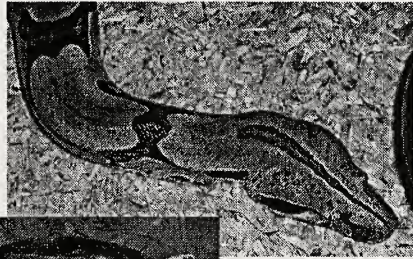
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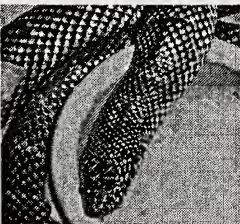


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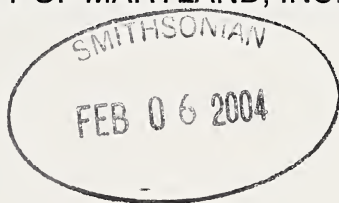
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31 DECEMBER 2003

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***Adelphicos quadrivirgatum* (Serpentes: Colubridae)  
in Hidalgo, Mexico, with Comments on its  
Relationships to *A. visoninum***

*Fernando Mendoza Quijano, José Ismael Campos Rodríguez, Juan Carlos López  
Vidal, Hobart M. Smith and David Chiszar.*

Abstract.

*Adelphicos q. quadrivirgatum* is recorded for the first time from Hidalgo, Mexico. Comparison of variation in this and other populations of the species indicate that *A. q. newmanorum* is identifiable only by pattern. The two taxa may be closely associated in the vicinity of Xilitla, San Luis Potosí. Known localities for *A. quadrivirgatum sensu stricto* are listed, and problematic records of that species are summarized. Populations on Atlantic slopes eastward from the Isthmus of Tehuantepec in Veracruz and Oaxaca represent *A. visoninum*. Those westward from Guatemala, in southern Veracruz, adjacent Oaxaca, northern Chiapas, Tabasco and Belize, represent *A. visoninum*, but are subspecifically distinct from *A. v. visoninum* of Guatemala and Honduras, as *A. v. acutirostris* Bocourt (1883).

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The genus *Adelphicos* embraces two complexes. The *A. veraepacis* complex occurs in the western highlands of Guatemala, Chiapas and Oaxaca. The *A. quadrivirgatum* (gender fide laDuc, 1995) complex extends on Atlantic slopes from Monterrey, Nuevo León (David Lazcano, pers. comm.) to Honduras, and on Pacific slopes in Chiapas and Guatemala. The former complex differs from the latter in lacking expansion of the anterior part of the anterior chinshields toward the lip; it was monographed by Campbell and Ford (1982), and an additional species was described by Campbell and Brodie (1988). We here deal solely with the *A. quadrivirgatum* complex.

The entire *A. quadrivirgatum* complex was considered a single species (e.g. Campbell and Ford 1982), until Smith *et al.* (2001) proposed that the three subspecies formerly recognized in the species (Smith, 1942) are separate species, *A. quadrivirgatum* and *A. visoninum* Cope (1866) on Atlantic slopes, and *A. sargii* (Fischer, 1885) on Pacific slopes of Chiapas and Guatemala. We are here primarily concerned with the former two.



*Adelphicos quadrivirgatum* Jan

We here report three specimens of this species from Hidalgo, the first known from the state (only mentioned by Canseco-Márquez *et al.*, in press). They are of special interest also because they are from an area between the known ranges of the nominotypical subspecies and *A. q. visoninum* (Taylor, 1950). They are as follows: ENCB (Escuela Nacional de Ciencias Biológicas, IPN) 11498, San Felipe, municipality of Orizatlán (21°10'25"N, 98°35'23"W), ca. 160 m elev., April, 1982; ITAH (Instituto Tecnológico Agropecuario de Hidalgo) 775, Coyolapa, mpio Atlapexco, ca. 2.5 km N Atlapexco (21°08'N, 98°20'50"W), ca. 160 m elev., 2001; and ITAH

Table 1. Comparison of Selected Characters of Hidalgo *Adelphicos quadrivirgatum* with Those Previously Recorded

	<i>A.q. quadrivirgatum</i>	<i>A. q. newmanorum</i>	Hidalgo
Female Subcaudals	32	41-44	36, 37
Male Subcaudals	36-49	47-50	tail inc.
Female Ventrals	124-138	141-155	141, 145
Male Ventral	131-146	139-142	139
Stripes	continuous	absent or interrupted	continuous

776, Chalahuiyapa, mpio Huejutla (20°09'N, 98°25'W), 170 m elev., 2001. All were collected in disturbed tropical deciduous forest (Rzedowsky, 1981). The two ITAH specimens were found dead on a gravel road.

In determining the subspecific identity of the Hidalgo specimens, it should be noted that the only alleged differences between the two subspecies are in number of ventrals and subcaudals, and in pattern (Martin, 1955; Taylor, 1950; Smith, 1942). Table 1 compares known data for these characters.

The variation in scalation of the Hidalgo specimens does not support distinction of the two subspecies on that basis: number of female ventrals, female subcaudals and male ventral are all intermediate. The only consistent difference is in pattern,

which in the present specimens corresponds with that of *A. q. quadrivirgatum*, to which we assign the Hidalgo sample. These are the northernmost specimens known of the subspecies, except perhaps for one from the Xilitla region, San Luis Potosí (Taylor, 1949, 1950), where Taylor (*op. cit.*) also recorded *A. q. newmanorum*, otherwise known only northward. The occurrence of a specimen referable to each subspecies in the Xilitla region (*fide* Taylor, *op. cit.*) may reflect altitudinal separation (inasmuch as the area is of rugged topography), intergradation, or sympatry of two species. Additional material will be required to resolve that problem.

South of Hidalgo, the range of *A. q. quadrivirgatum* extends into northeastern Puebla, as indicated by the following material. EBUAP 1094, Zacatipan, 600 m (20°02'N, 97°26'W); EBUAP 112, Finca San José, 4 km W Santiago Yacuictlalpan, 360 m (20°03'N, 97°26'W); EBUAP 1095, 1 km SW Yohualichan, 750 m (20°03'N, 97°28'W); EBUAP 1096, 1.5 km E Yohualichan, 725 m (20°03'N, 97°30'W); EBUAP 1097, Tatahuitlapan, 3 km SW Yohualichan, 550 m (20°04'N, 97°30'W); EBUAP 1098, Octimaxal Norte, 930 m (20°02'N, 97°30'W); EBUAP 1099, 1338, 1 km N El Paraíso, 720 m, mpio Huitzilán de Serdén (Canseco-Márquez *et al.*, 2000). All except 1099 and 1338 are from mpio Cuetzalan del Progreso.

In the state of Veracruz, *A. q. quadrivirgatum* is known to occur at Jicaltepec (Smith, 1942), to which the original type locality of "Mexico" was restricted by Smith and Taylor (1950). No other confirmed record for the state is known to us, although probably some of those cited as *A. quadrivirgatum* in Pérez-Higareda and Smith (1991) are actually of this species. However, all specimens of *A. quadrivirgatum* cited in that work from the Los Tuxtlas area actually are *A. visonium* (Pérez-Higareda, pers. comm.), confirming the same identification recorded by Ramírez-Bautista (1977) for material from that area.

In northeastern Oaxaca, confirmed records of *A. q. quadrivirgatum* are available from the Sierra de Juárez at 2 km NE Vista Hermosa, 1800 m (MZFC 6522); mpio Juan Yavé (MZFC 1596); and Metates, mpio Valle Nacional, 800 m (MZFC 2239). Cadle (1984) recorded a specimen from hwy 185, 8 km S Veracruz state line. Apparently the southern limit of the range of *A. q. quadrivirgatum* is represented by these specimens.

The specimen from Pochutla, Oaxaca (Smith, 1942) is clearly *A. quadrivirgatum*, but the locality is in error, as neither that species nor *A. visonium* is known from Pacific slopes; both are limited to Atlantic slopes.

*Adelphicos visoninum* Cope

Near the Isthmus of Tehuantepec, in Veracruz and Oaxaca, *A. visoninum* replaces *A. quadrivirgatum*. The known Veracruz records are cited in a preceding paragraph.

Several specimens from Oaxaca in UCM are clearly *A. visoninum*, all having the anterior chinshields separated from the lip by a very narrow third infralabial. The localities represented are 12 de Julio, mpio Mixe (39891-2); mpio Mixe (52516, probably from the vicinity of 12 de Julio); Palomares, mpio Juchitán (49321); Lag Muelles, Palomares, mpio Juchitán (39893); and Vista hermosa, mpio Ixtlán (39894, 52385). All were collected by Thomas MacDougall. Occurrence in northern Chiapas was also confirmed at Palenque (Smith, 1942).

The confirmed records of specimens with no third infralabial (the character of *A. quadrivirgatum*) from within the range of *A. visoninum* have been assigned to *A. quadrivirgatum* on that basis (e.g. Smith, 1942), in error. They are widely scattered, with no geographic continuity. The third infralabial in Mexican *A. visoninum* is very narrow – distinctly narrower than in Guatemalan specimens of the same species – and may on that account be subject to some variation, contrary to the populations in Guatemala. Included among these aberrant specimens are those recorded by Smith (1942) from Ocozucoautla, Chiapas, and Silkgrass Creek, Belize, and ENCB 1959, 14 km W Raudales, Chiapas. Two others are UCM 39890 from Palomares, mpio Juchitán, Oaxaca, and UCM 60077, from “Oaxaca.” Both UCM specimens were collected by Thomas MacDougall, hence the latter specimen is probably from the same region as the former. At least the Palomares specimen is definitely from the same locality as others that conform with *A. visoninum* (see above). That only one taxon is involved is indicated also by the fact that male ventrals of *A. visoninum* are only 117-129, including the large series reported by Wilson and Meyer (1985) from Honduras, as opposed to 131-146 in male *A. quadrivirgatum*. All male ventrals for Mexican and Belize “*A. quadrivirgatum*” (those without the third infralabial), fall within the range of *A. visoninum*. The number of female ventrals overlaps in the two species.

Variability in occurrence of the third infralabial apparently does not exist in populations of *A. visoninum* (type locality “Honduras”) from Guatemala and Honduras; the third infralabial is regularly present (and larger than in Mexican *A. visoninum*) in the 66 UCM specimens available from Guatemala (Sayache, Petén Tamahú and Beleu, Alta Verapaz), and in the 62 reported from Honduras by Wilson and Meyer (1985).



The Mexican specimens of *A. visoninum* differ from the Guatemala/Honduras populations in (1) the very small size of the third infralabial, even occasionally absent (vs larger, regularly present); (2) the light dorsal ground color, on which the typical triple dark stripes are clearly evident (vs ground color quite dark, sometimes obscuring completely the dark stripes); (3) absence of ventral pigmentation even on the head (vs usually extensive ventral pigmentation, always on head); and (4) small size, maximum 351 mm total length (vs 526 mm). The differences are striking, and may well indicate specific rank for the two populations. At least they justify resurrection of *A. v. acutirostrum* Bocourt (1883) for the Mexican and Belize populations. Its original type locality "Mexico" is here restricted to Palenque, Chiapas, where the taxon has previously been reported (Smith, 1942). Presumably Duges' (1896) record for "Tabasco," and Müller's (1882) for Tenosique, Tabasco, are referable to *A. v. acutirostrum*.

Key to the Species and Subspecies of the

*A. quadrivirgatum* Complex

- 1A. Subaudals 24-29 in females (31), 29-35 in males (33); third infralabial always present ..... *A. sargii*
- B. Subcaudals 31 or more in females, 36 or more in males; third infralabial present or absent ..... 2
- 2A. Third infralabial absent, or, if present, male ventrals 131-146 ..... *A. quadrivirgatum* ..... 3
- B. Third infralabial present or, if absent, male ventrals 117-129 ..... *A. visonum* ..... 4
- 3A. Stripes on body absent, broken or weak ..... *A. q. newmanorum*
- B. Stripes on body continuous, prominent ..... *A. q. quadrivirgatum*
- 4A. No ventral pigmentation, even on head; ground color light, triple dark stripes prominent; third infralabial extremely narrow, occasionally absent ..... *A. v. acutirostrum*
- B. Ventral pigmentation usually extensive, always present on head; ground color dark, the triple dark stripes usually partially obscured; third infralabial a little wider, always present ..... *A. v. visoninum*

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## Analysis of Phenotypic Variation in the Lizard *Sceloporus cautus* and Adjacent Populations of Related Species

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### Abstract.

Data on external morphology of *Sceloporus cautus* confirm its allospecificity from *S. olivaceus* and *S. undulatus/edbelli*. On the basis of these data *S. cautus* is referred to the *olivaceus* group of Wiens and Reeder. *S. cautus* is reported for the first time from the Mexican state of Tamaulipas.

In 1982 GMF was awarded a Master of Science degree at the University of Texas at El Paso, in part based on a dissertation analyzing the external morphology of the then controversial nominal species *Sceloporus cautus* in comparison with the adjacent, related populations of *S. olivaceus* and *S. "undulatus"* (Ferguson, 1982). At that time *S. edbelli* was not known, hence the "undulatus" populations sampled actually represented both *S. edbelli* and *S. undulatus consobrinus*. We here maintain the usage of "undulatus" as in the dissertation, with however the understanding that in this context the name refers to both taxa. The differences here noted between *S. cautus* and *S. "undulatus"* apply equally well to *S. edbelli* and *S. undulatus consobrinus*, the adjacent subspecies. Indeed, *S. edbelli* was originally thought to be a subspecies of *S. undulatus*.

Although some 21 years have passed since the dissertation was completed, the identity and relationships of *S. cautus* remain enigmatic. The latter and *S. olivaceus* clearly belong to the same group, as shown hereinafter, based on phenetic similarity so great that they have been suggested as synonyms by various workers (Bussjaeger, 1971; Hall, 1973). Confusion of *S. cautus* with *S. "undulatus"* and *S. olivaceus* is evident in the literature as well as in museum identifications.

Therefore we here exhume the critical morphological data given in the dissertation, comparing the three species. Twelve characters were regarded as the most significant, here numbered as in Table 1.

1. Dorsals. Number of transverse scale rows counted middorsally from interparietal to the level of the posterior margins of the hind limbs (directly above the vent).

2. Scales around the midbody. Number of longitudinal scale rows counted around the middle of the body.
3. Femoral pores. Combined number of femoral pores along the posterior border of the thighs.
4. Interfemoral pore scales. Fewest number of scales in a row separating medial ends of the pore series.
5. Dorsal body blotches. Number of dorsal body blotches (or crossbars) along medial edge of dorsolateral light stripe, combined for the two sides. The character could not be determined where the anterior blotches were fused longitudinally.
6. Dorsolateral stripe scales. The combined number of scale rows included within the width of the dorsolateral light stripes. One row consisted of the area between the keels of adjacent scales.
7. Scales between dorsolateral stripes. Number of longitudinal scale rows between the dorsolateral light stripes. One row consisted of the area between the keels of adjacent scales.
8. Gular semeion separation (males only). Fewest number of scales between medial edges of posterior blue gular semeions, disregarding the black border.
9. Abdominal semeion separation. Fewest number of scales between the medial edges of the abdominal semeions, including the black borders where present.
10. Tail length divided by snout-vent length (TL-SVL).
11. Gular semeion extent (males only). Gular semeion extension anterior to level of ear openings (2) or not (1).
12. Converging postocular stripes. Two dark, narrow lines, one originating at the upper, the other at the lower border of eye. Fusion of the lines in temporal regions, character state 1; absence of fusion, character state 2.

Table 1 shows that the more diagnostically significant differences between *S. cautus* and *S. "undulatus"* are 1, 3, 4, 10, 11 and 12, and those between *S. cautus* and *S. olivaceus* 1, 2, 7, 10 and 12. There are no categorical distinctions of *S. cautus* from *S. "undulatus"* (although 4 is nearly so), and none from *S. olivaceus*. Several less diagnostically significant differences exist between *S. cautus* and *S. "undulatus"* alone (2, 7, 9), *S. olivaceus* alone (5), and both (6, 8).



Table 1. Analysis of variance comparing *S. cautus* with *S. "undulatus"* and *S. olivaceus* for each of 12 morphological characters (sexes combined except for male characters). Ranges are followed by the deviation (SD). F-values significant at the 0.01 level are indicated by \*.

No.	<i>S. cautus</i>	<i>S. "undulatus"</i>	<i>S. olivaceus</i>
1	33-41 (36.85) N=188 SD=1.81	36-48 (41.60) N=116 SD 2.55 F=358.53*	28-36 (31.49) N=116 SD=1.31 F=771.40*
2	36-45 (39.62) N=187 SD=1.83	36-48 (41.96) N=117 SD=2.49 F=88.80*	32-40 (35.43) N=110 SD=1.86 F=361.03*
3	20-31 (24.68) N=185 SD=2.03	27-42 (33.41) N=116 SD=2.32 F=1177.76*	20-30 (25.25) N=115 SD=1.96 F=5.76
4	8-14 (10.76) N=185 SD=1.28	4-8 (5.52) N=115 SD=1.01 F=1381.07*	7-12 (9.40) N=114 SD=1.2 F=81.76*
5	14-23 (19.16) N=142 SD=1.38	10-22 (19.78) N=18 SD=2.84 F=2.35	14-22 (16.76) N=63 SD=1.38 F=132.65*
6	1-2 (1.14) N=123 SD=0.24	1-2 (1.50) N=62 SD=0.33 F=70.16*	1-2 (1.77) N=90 SD=0.27 F=308.46*
7	6-8 (6.62) N=123 SD=0.52	5-8 (7.00) N=62 SD=0.65 F=18.65*	3-6 (4.30) N=91 SD=0.53 F=1029.54*
8	1-9 (5.44) N=84 SD=1.53	0-7 (2.49) N=61 SD=1.76 F=115.33*	5-11 (8.26) N=43 SD=1.35 F=104.02*
9	3-8 (5.54) N=95 SD=0.90	0-7 (4.60) N=59 SD=1.30 F=28.38*	4-8 (5.87) N=47 SD=0.97 F=4.17
10	1.04-1.58 (1.30) N=87 SD=0.10	1.19-2.11 (1.62) N=49 SD=0.15 F=224.44*	1.38-2.12 (1.76) N=75 SD=0.16 F=495.31*
11	1-2 (1.05) N=86 SD=0.21	1-2 (1.89) N=61 SD=0.32 F=363.64*	1 (1.00) N=43 SD=0.0 F=2.07
12	1-2 (1.17) N=175 SD=0.37	2 (2.00) N=117 SD=0.0 F=585.01*	1-2 (1.95) N=111 SD=0.23 F=393.13*

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Data were taken on seventeen other characters, as follows, all of which showed at least some level ( $p \leq 0.01$ ) of statistical significance, except for two (E, I).

A. Neck scales. Number of longitudinal rows of dorsals across neck between uppermost auricular lobules.

B. Supraoculars. Combined number of supraocular scales, including smaller scales if obviously associated with supraoculars rather than with adjacent scales.

C. Lorilabial rows. Fewest number of scales in horizontal rows between subocular scales and supralabials (combined).

D. Auricular lobules. Number of enlarged scales along anterior margin of ear, combined.

E. Fourth toe lamellae. Combined number of scales along ventral surface of 4<sup>th</sup> toe.

F. Ratio, 4th toe length/hind leg length (HL).

G. Ratio, foreleg length/HL.

H. Ratio, HL/snout-vent length (SVL).

I. Ratio, snout-axilla length (SA)/SVL.

J. Ratio, head width, maximum at anterior ear border (HW)/SA.

K. Ratio, HW/snout to anterior edge of ear.

L. Ratio, Head width between lateral edges of superciliaries (HS)/HW.

M. Ratio, HS/snout to occiput.

N. Ratio, interparietal length/width between lateral edges of parietals.

O. Head pattern (excluding *S. "undulatus"*) of dark stripes.

P. Postrostral-subnasal in contact below nasal.

Q. Prefrontals in contact (excluding *S. "undulatus"*) or separated by one zygous scale.

Statistically significant differences exist between *S. cautus* from both of the other species in characters A (the most significant in this set), C, G, J, K, L, M, N and

P; from *S. "undulatus"* alone in B and D; and from *S. olivaceus* alone in F, H, O and Q. No significant differences were found in E or I.

Geographic range is an important character also. That of *s. cautus* is west from the western edge of the Sierra Madre Oriental, barely entering Tamaulipas on the northeastern edge of the Mexican Plateau, and extending south from southeastern Coahuila and central Nuevo León to southern San Luis Potosí, east from the southern half of Zacatecas. It is known only from the Mexican states mentioned. A narrow zone of apparent sympatry of *S. cautus* and the *S. edbelli* component of *S. "undulatus"* occurs in Zacatecas. *S. olivaceus* is narrowly dichopatric (possibly parapatric) with *S. cautus*, occurring to the north of its range and east of the Sierra Madre at their common latitudes.

Subjectively, both *S. cautus* and *S. "undulatus"* are categorically different from *S. olivaceus* in behavior and habitat (terrestrial vs arboreal behavior, and non-forested vs forested habitat, respectively). There is a significant difference ( $p<0.001$ ) between the distributional elevation of *S. olivaceus* (12-1525 m,  $M=530$  m) and that of *S. cautus* (1000-2200,  $M=1860$ ) in the study area. Altitudes recorded for "*S. undulatus*" were 100-2200 m ( $M=1130$ ).

The aggregate of differences between these three taxa leaves no doubt that they are allosppecific. Their relationships remain in question. Sympatry between *S. cautus* and *S. "undulatus,"* and their nearly categorical difference in at least one character, suggests that they are more distantly related to each other than *S. cautus* is to *S. olivaceus*. The ranges of the latter two species are allopatric (possibly parapatric) and none of their differences are categorical. On these bases we regard *S. cautus* as a member of the *olivaceus* group of Wiens and Reeder (1997), rather than the *undulatus* group, in which it has generally been placed (e.g. Smith, 1939; Sites *et al.*, 1991), or the *spinosus* group (Larsen and Tanner, 1975).

The following key distinguishes the three taxa in external morphology.

- 1A. Interfemoral pore scales 4-7 ..... 2
- B. Interfemoral pore scales 8-14 ..... 3
- 2A. Interfemoral pore scales 4-7 (96.5%); femoral pores 29-42  
    (99.9%); dorsals 37-48 (98.3%); fused postocular dark  
    lines 0% .....*S. "undulatus"*
- B. A combination of interfemoral pore scales 7; femoral pores less than 29; and  
    dorsals less than 37 ..... *S. olivaceus* (<4%)



- 3A. A combination of interfemoral pore scales 8, femoral pores >30, and dorsals >39 ..... *S. "undulatus" (<4%)*
- B. Interfemoral pores scales >8, OR, if interfemoral pore scales 8, then femoral pores not >30 and dorsals not >39 ..... 4
- 4A. Interfemoral pore scales 8-14 (100%), 9.2% 13 or more; dorsals 34-41 (97.9%); scales around body 38-45 (89.3%); scales between dorsolateral light lines 6-8 (100%); fused postocular dark lines (83.4%) ..... *S. cautus*
- 4B. Interfemoral pores scales never more than 12; dorsals 28-33 (92.2%); scales around body 32-37 (84.5%); scales between dorsolateral light lines 3-5 (97.8%); fused postocular dark lines (5.4%) ..... *S. olivaceus*

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## 2001-2002 Anurans, Exclusive of *Rana*, from Durango and Chihuahua, Mexico

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### Abstract.

Fifteen anuran species are reported, including a first state record (*Pachymedusa dacnicolor*) as well as numerous new locality records for the state of Chihuahua, Mexico.

The material reported here was obtained in the summers of 2001 and 2002, all from Chihuahua except for the few, so indicated, from Durango. The salamanders and *Rana* collected at the same time have been reported elsewhere (Lemos-Espinal *et al.*, in press a, b). All specimens are in the collection of the Unidad de Biología, Tecnología y Prototipos (UBIPRO), UNAM, to which catalog numbers refer.

*Bufo cognatus* Say. 7396, 8001-14, betw Ejido San Dionisio and Sierra La Campana, mpio Tlahualilo, Durango (26°12'9.1"N, 103°41'47.2"W), 111 m, 1-2 September; 10287, pasture E side Ojo Laguna, betw Ejido and lago (29°36'47.8"N, 106°10'34.1"W), 1540 m, 15 September. This latter specimen is 22 mm SVL, taken with a large series, 10201-10363.

The species was previously reported from Ejido San Dionisio by Lemos-Espinal *et al.* (2001).

At both sites *Bufo debilis* was also collected. Stebbins (2003) mapped the range of *B. cognatus* into the Sierra Madre Occidental, where it does not occur.

*Bufo debilis insidiator* Girard. 6792, Llano El Victorio (29°55'15.9"N, 104°39'58.7"W), 1282 m, 9 April; 7598-7602, Rancho La Bamba (30°5'11.7"N, 105°24'30.9"W), 1390 m, 30 July; 7609-10, Rancho El Setenta (31°11'16.2"N, 106°30'20.7"W), 1334 m, 1 August; 7892, betw Ejido San Dionisio and Sierra La Campana, mpio Thahualilo, Durango (26°12'9.1"N, 103°41'47.2"W), 1111 m, 1 September; 10364-8, 10384, pasture E side of Ojo Laguna, betw Ejido and lago (29°26'47.8"ÆN, 106°19'34.1"W), 1540 m, 15 September.

*Bufo marinus* (Linnaeus). 8579-8729, Batopilas (27°6'53.8"N, 107°39'52.4"W), 867 m, 16 June. All are transformlings ~19 mm SVL, some with vestige of the tail.



The species was first reported from Chihuahua by Tanner (1989).

*Bufo mazatlanensis* Taylor. 7327, Satevo (26°59'25.8"N, 107°25'52.9"W) 567 m, 18 June; unassigned no., Batopilas (27°1'34.1"N, 107°45'44.5"W), 435 m, 18 June; 10608, Arroyo Las Boregas (27°23'4.3"N, 108°32'21.1"W), 470 m. All have a conspicuously deep valley between the interorbital crests, and a small, vertically oval parotoid gland. A vertebral light stripe is complete in two, anterior half only in one.

*Bufo mexicanus* Brocchi. 8074-8, Río Papigochi at La Junta, mpio Guerrero (28°27'54.0"N, 107°19'39.4"W), 2103 m, 6 September; 8148, Arroyo Seco, km 16.5 hwy 127 (28°15'45.4"N, 107°29'31.5"W), 2191 m, 7 September; 8299-8300, Cusarare, small stream (27°37'22.4"N, 107°32'38.4"W), 2302 m, 9 September; 8419, Napuchis, mpio Guerrero (27°18'19.1"N, 107°31'40.2"W), 2179 m, 11 September; 8494, Basigochi de Aboreachi, mpio Guachochi 927°12'12.2"N, 107°22'45.0"W), 2409 m, 11 September; 8541, San Pablo Balleza (26°55'48.3"N, 106°20'57.3"W), 1638 m, 11 September; 9534-40, km 7.8, San Juanito-Basaseachi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 15 July; 9593-4, km 12, San Juanito-Basaseachi (27°58'17.9"N, 107°49'15"W), 2375 m, 15 July; 9650, 13 km N Maguarichi (27°53'58.8"N, 107°56'35.1"W), 1923 m, 19 July; 9671-2, Gurichivo-Basogachi (27°59'11.3"N, 107°51'55.6"W), 2127 m, 19 July; 9675-6, 2 km S jct San Juanito-Basaseachi and hwy to Maguarichi (28°1'8.1"N, 107°48'57.4"W), 2313 m, 19 July; 10579-80, km 114 Creel-Guachochi 927°35'32.6"N, 107°32'56.9"W, 2139 m, 26 September; 10943-64, km 7.6 San Juanito-Maguarichi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 12 October.

A few adults are very dark, somewhat obscuring the diagnostic light band across the eyelids. Webb (1972), although concerned primarily with distinguishing *B. speciosus* from *B. mexicanus*, provides important data distinguishing the latter species from the sympatric *B. occidentalis*. The latter occurred with *B. mexicanus*, *B. woodhousii* and *Scaphiopus multiplicata* at km 7.6, San Juanito-Basaseachi.

*Bufo occidentalis* Camerano. 8074-8, Río Papigochi at La Junta (28°27'54.0"N, 107°19'39.4"W), 2103 m, 6 September; 8730-93, km 121.7, hwy 127, nr detour to Tejaban, mpio Guachochi (27°33'11.5"N, 107°31'47.3"W), 2332 m. 10 September; 8794-7, Río Papigochi at Guerrero (28°40'6.8"N, 107°34'5.5"W), 1979 m, June 15; 9511-33, km 7.8, San Juanito-Basasacheachi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 15 July; 9553, 9621, Huerta de Manzana y Durazno, N Rancho Mojarachi (27°51'46.4"N, 107°55'47.0"W), 2211 m, 15-16 July; 9662-3, Aserradero (27°55'5.2"N, 107°54'15.4"W), 2172 m, 19 July; 9690-1, Huevachic (28°6'26.2"N, 108°0'03.1"W), 2115 m, 20 July; 9702-5, km 82, San Juanito-Basaseachi (28°9'25.3"N, 108°6'26.9"W), 2320 m, 20 July; 10563, Arroyo del Agua, nr Maguarichi

(27°54'45.6"N, 107°58'49.2"W), 2083 m, 25 September; 10960, km 7.6 San Juanito-Maguarichi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 12 October.

Nos. 8730-93 are transformlings ~12 mm SVL, with a vestigial tail.

Relatively few previous records for Chihuahua exist (Tanner, 1989, as *Bufo simus*). Riemer (1955) first reported the species for the state, at Río Gavilán, 7 mi SW Pacheco, 5700 ft. Van Devender and Lowe (1977) and Van Devender *et al.* (1989) reported it from other northern localities. The present localities considerably augment knowledge of the distribution of the species in the state.

***Bufo punctatus*** Baird and Girard. 6751-2, 7024-5, Rancho El Escondido (29°55'12.6"N, 105°32'9.8"W), 1426 m, 8 April, 9 June; 7539, Rancho El Gatunozo, mpio Camargo (26°6'50.7"N, 104°5'51.4"W), 1325 m, 28 July; 9166, Cañon de Balleza, mpio Balleza (26°57'45.7"N, 106°26'9.6"W), 1699 m, 12 May; 9847, 1 km S Red Rock, Río Riedras Verdes (30°22'11.4"N, 108°14'8.7"W), 1682 m, 24 July; 10130-1, plains base Sierra del Nido, nr La Providencia (29°40'22.3"N, 106°37'4.4"W), 1569 m, 6 August; 10378-9 pasture E side Ojo Laguna, betw Ejido and lago (29°26'47.8"N, 106°19'34.1"W), 1540 m, 6 August.

All lack a vertebral light line, have light-tipped warts and a black-speckled chest, thus conforming with characteristics of populations in the eastern part of the range of the species, but different from the southwestern specimen reported by Lemos-Espinal *et al.* (2001). No. 10131 is 69 mm SVL.

This species was taken with *B. cognatus*, *B. debilis*, *Scaphiopus couchii* and *Spea stagnalis* between Ojo Laguna and Ejido.

***Bufo woodhousii australis*** Shannon and Lowe. 7208-96, 8561-78, Río Verde, Pacheco (30°51'1.7"N, 108°20'29.4"W), 1949 m, June 14; 10015, middle Cañon de la Madera, Sierra de San Luis (31°13'41.1"N, 108°44'5.5"W), 1638 m, 27 July. The specimens from Pacheco are all transformlings, 10-13 mm SVL.

***Hyla arenicolor*** Cope. 6701-2, Ejido Dolores, Guadalupe y Calvo (25°58'57.6"N, 107°10'11.5"W), 954 m, 3 April; 8080-82, Río Pagicochi at San Pedro, mpio Guerrero (28°23'35.9"N, 107°26'8.6"W), 2081 m, 6 September; 8084-8147, Arroyo Seco, km 16.5 hwy 127 (28°15'45.4"N, 107°29'35.1"W), 2191 m, 7 September; 8276-9, hwy 127, mpio Bocoyna (27°39'51.2"N, 107°33'53.3"W), 2313 m, 9 September; 8288-96, 8313-5, Cusarare, small stream (27°37'22.4"N, 107°32'38.4"W), 2302 m, 9 September; 9024, 9054-7, 9246, Arroyo El Camuchil (27°1'34.1"N, 107°45'44.5"W), 435 m, 8 May; 9490-3, 1 km N Humira (27°25'43"N, 107°29'24.6"W), 1906 m, 13 July; 9664, Aserradero 500 m N detour Mojarachi



(27°55'5.2"N, 107°54'15.4"W), 2172 m, 19 July.

Most are small, 24 mm SVL or less; others are 29–38 mm SVL. The specimens from El Camuchil were taken at a surprisingly low elevation. No water was in the stream bed, but the frogs were in a quite wet cave – a typical habitat.

*Hyla wrightorum* Taylor. Seven: 6701-2, Ejido Dolores, Guadalupe y Calvo (26°58'57.6"N, 107°10'11.5"W), 954 m, 3 April; 8241-2, km 48 Creel-San Rafael, mpio Urique (27°31'18.2"N, 107°50'50.5"W), 2313 m, 8 September; 8301-6, Cusarare, small stream (27°37'22.4"N, 107°32'38.4"W), 2302 m, 9 September; 8417-8, Napuchis, mpio Guerrero (27°18'19.1"N, 107°31'40.2"W), 2179 m, 11 September; 8535, Guazarare, mpio Guachochi (27°3'47.2"N, 107°12'5.0"W), 2300 m, 11 September; 9542 [9542-46], km 7.6, San Juanito-Basaseachi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 15 July 9590-2, km 12, San Juanito-Basaseachi (27°58'17.9"N, 107°49'15.0"W), 2375 m, 15 July; 9673-4, Gurichivo-Basogachi (27°59'11.3"N, 107°51'55.6"W), 2127 m, 19 July; 10564, Arroyo del Agua, nr Maguarichi (27°54'45.6"N, 107°58'49.2"W), 2083 m, 25 September.

*Pachymedusa dacnicolor* (Cope). A single, slightly injured, partially transformed larva (9068) 28 mm SVL, tail ~10 mm, is from Ejido la Junta, 203 km NW Batopilas (27°1'34.1"N, 107°45'44.5"W), 435 m, 19 May. Its identification, primarily due to its small size, is based on elimination. It is not *Hyla arenicolor*, of which specimens of much the same size are available from nearby El Camuchil, because of its smooth skin and different pattern. No other hylids are known from southwestern Chihuahua, although *Pachymedusa dacnicolor*, *Smilisca baudinii* and *Pternohyla fodiens* are known from nearly Sonora and Sinaloa. It differs from both of the latter two, totally lacking a pattern. Its toe webbing is much shorter than in *S. baudinii*, and the metatarsal tubercles are much smaller than in *P. fodiens*. All of these features correspond with the characters of *P. dacnicolor*, with which it agrees in pigmentation. The body is rather densely and uniformly pigmented, and the limbs are much more lightly pigmented (appearing almost white to the naked eye) but also uniformly pigmented. The species is known from very near Chihuahua, 13 km ESE Alamos, Sonora (Duellman, 2001), but the present specimen is the first known of the species from Chihuahua.

The specimen was taken from the Río Batopilas in an area of dense aquatic vegetation, where numerous *Rana magnaocularis* were seen. The frogs were very wary, leaping into the water upon close approach; only three small *Rana* (28–42 mm SVL) could be caught, along with the *Pachymedusa*.



*Scaphiopus couchii* Baird. 7591, Cd. Coyame (29°27'48.2"N, 105°5'1.2"W), 1270 m, 29 July; 7732 llano 4 km N Villa Ahumada (30°41'20.7"N, 106°30'57.2"W), 1202 m, 2 August; 7791-3, Rancho El Vergel, nr Samalayuca, mpio Juárez (31°13'4.5"N, 106°37'51.7"W), 1009 m, 1 August; 7893-5, 7897-8, Ejido San Dionisio, mpio Tlahualilo, Durango (26°12'9.1"N, 103°41'47.2"W), 1111m, 1 September; 10128-9, plains at base of Sierra del Nido, nr La Providencia (29°40'22.3"N, 106°37'4.4"W), 1569 m, 6 August; 10369-77, pasture E side of Ojo Laguna, betw Ejido and lago (29°26'47.8"N, 106°19'34.1"W), 1540 m, 15 September; 10505, Ojo de Agua, Estación Guzmán (31°13'19.7"N, 107°27'8.2"W), 1449 m, 21 September; 10634, Jaco (27°57'34.1"N, 103°57'16.0"W), 1283 m, 13 October.

*Spea bombifrons* (Cope). 7611-4, Rancho El Setenta (31°11'16.2"N, 106°30'20.7"W), 1334 m, 1 August. Two adults and two transforming larvae, 28 mm SVL, tail 27, 29 mm, partially larval mouthparts.

*Spea multiplicata* (Cope). 9534-40, km 7.6 San Juanito-Basaseachi (27°58'41.1"N, 107°39'43.0"W), 2402 m, 15 July; 10130-1, plains base of Sierra del Nido, nr Providencia (29°40'22.3"N, 106°37'4.4"W), 1569 m, 6 August.

*Spea stagnalis* (Cope). 7732, 4 km N Villa Ahumada (30°41'20.7"N, 106°30'57.2"W), 1202 m, 2 August; 7791-3, Rancho El Vergel, nr Samalayuca (31°11'58.8"N, 106°35'44.3"W), 1248 m, 1 August; 10369-77, 10382-3, pasture E side Ojo Laguna, betw Edjido and lago (29°26'47.8"N, 106°19'34.1"W), 1540 m, 15 September.

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## The Madrean Alligator Lizard of the Sierra del Nido, Chihuahua, Mexico (Reptilia: Sauria: Anguidae)

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Among specimens collected by JLE in Chihuahua during the summer of 2002 are eleven examples of the genus *Elgaria*. Ten, from the central western Sierra Madre Occidental, are typical *E. k. kingii*. The other specimen is from the isolated Sierra del Nido, close to the north central part of the state, farther east than the genus has ever been taken before in Chihuahua. That specimen exhibits pattern features not known in *E. kingii*, the only other species of the genus in Chihuahua. It is here named

*Elgaria usafa* sp. nov.

### Holotype.

UBIPRO (Unidad de Biología, Tecnología y Prototipos, UNAM) 10177, taken at the ruins of Rancho El Mesteño Chiquito (27°51'46.5"N, 107°55'47.0"), Sierra del Nido, 2223 m, on August 8 by JLE and MJI.

### Diagnosis and Definition.

A member of the *Elgaria kingii* species complex with dim, dark tan interspaces mostly one scale long between uniformly dark brown or black crossbars; numerous, irregular black spots and vertical streaks, interspersed with light scales, on sides of body; most of lateral fold dark; dorsal surfaces of head and neck anterior to the interspace on the anterior border of the crossband at foreleg level nearly uniformly dark, lacking any light marks except for scattered small light flecks. Reduced internasals and lateral supraoculars remain to be evaluated with additional material.

### Description.

The only known specimen, the holotype, is 130 mm SVL – about the same as the maximum recorded for *E. kingii* (Stebbins, 2003). Dorsal scale rows 16; ventral scale rows 12; dorsals posterior to interparietal 53; ventrals mental to preanals inclusive 69.

Two supranasals broadly in contact medially posterior to rostral; no internasal on left, a small, elongate one on right at the side of the frontonasal; latter large, partially fused with right prefrontal; frontal contacting interparietal, separating the two frontoparietals; parietals 1-1.

Five large medial and two small lateral supraoculars on each side; 5-5 superciliaries; 2-2 postnasals; 2-2 loreals; 1-1 canthals above anterior loreal and contacting posterior loreal, upper postnasal and frontonasal (and, on the right side, the posterior end of the internasal). Preoculars 1-1, suboculars and postoculars 2-2; supralabials 10-10; anterior temporals 3-3; posterior temporals 4-4, none excluded from an anterior temporal; infralabials 10-10; postmentals 1-1, in medial contact and contacting the first two infralabials; three large chinshields on each side, anterior pair in medial contact, all separated from infralabials. Tail incomplete.

Dorsal color very dark, the light interspaces only dimly distinct from the 9 (10) dark crossbands on body, the first at foreleg level. Light interspaces between crossbands mostly one scale long, with some narrow interruptions by adjacent dark bands; latter 3-4 scales long, and little if any darker on their posterior borders than anterior to them; sides of body with irregular, vertical rows of dark or dark-edged scales interspersed among white scales; lateral fold mostly dark, with scattered, small light spots, each covering a few granules; lateral three rows of ventrals with dark edges on numerous scales; ventral surfaces of head, body and tail unmarked. No light marks on dorsal surfaces of the black head and neck anterior to the light border of the crossband at foreleg level, except for tiny, scattered light flecks; supralabial area strongly barred.

### Comparisons.

The ten examples previously mentioned of *E. k. kingii* are the chief bases for comparison with *E. usafa*, augmented by the guides and revisions by Good (1988), Stebbins (2003), and Webb (1962, 1970). Pattern differences are categorical, consistent in the material available and in the literature, and therefore indicative of species rank. In *E. kingii*, light stripes and other markings on a dark head and neck are regularly present except where the entire area is light; the interspaces between the crossbands are sharply distinct and two or more scales long; the crossbands are dark brown with black posterior borders; the sides of the body are less extensively and less irregularly mottled; and the lateral fold has considerably more extensive light areas.

The quantitative differences in scales (single, reduced internasal, and two lateral supraoculars) of the single *E. usafa* from *E. kingii* are subject to variation in the latter species and likely will not prove with further material to be taxonomically useful. Among the 10 *E. kingii* examined, one has no internasals, one has a tiny one on one side, and one has the two scales well separated medially. Six of the 10 have 3-3 lateral supraoculars; three have 2-3; and one has 2-2. However, the latter and one with 2-3 lateral supraoculars have an anomalous relationship with the superciliary series, which in both cases are interrupted, having 3+1-3-1 and 2+1-5 scales respec-

tively, instead of the usual continuous series of 4 to 6 scales. In *E. usafa* the superciliaries are 5-5 in an uninterrupted series.

### Etymology.

The specific name *usafa* is an acronym for United States Air Force Academy, the personnel of which, particularly of the Department of Biology, made the semester spent there by one of us (DC) a cherished memory. USAFA also generously supported the work that led to the discovery of *E. usafa*.

### Remarks.

A few decades ago, this taxon would probably be regarded as a subspecies of *E. kingii*, to which it is obviously closely related. An example of such points of view is the endemic *Crotalus willardi amabilis* Anderson of the Sierra del Nido. Current understanding, however, regards categorically distinct, isolated populations of any species group as evolutionarily independent, hence species. The present sample exhibits a pattern unlike that of any other taxon of the *E. kingii* complex, and is widely isolated from others; we therefore conclude that it represents a species.

### Acknowledgments.

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## Book Review

**Amphibians and Reptiles of Delmarva**, by James F. White, Jr. and Amy Wendt White, 2002. xvi + 248 pp. + 96 pls. Tidewater Publishers, Centreville, Maryland. ISBN 0-87033-543-X, (paperback) \$14.95.

The authors have provided the first field guide to the amphibians and reptiles of the Delmarva Peninsula which consists of the entire state of Delaware and portions of the states of Maryland and Virginia. The first naturalists having published on the herpetofauna of Delmarva were Henry W. Fowler and Roger Conant. In the early part of the 12<sup>th</sup> century, Fowler collected extensively, and published his findings in *Copeia*. In 1936 Roger Conant began his systematic and comprehensive Delmarva investigation into the herpetofauna, which was followed by Clyde F. Reed studies in the 1950s.

The book opens with a brief introduction and historical account of the Delmarva Peninsula along with a short introduction on the physiography of the area. The Atlantic Coastal Plain and Piedmont Provinces cover the major portion of the territory separated by the Fall Line. The Fall Line serves as a vital boundary for many of the Delmarva amphibian and reptile species. This is followed by a short discussion on how to find the organisms in addition to guidelines for handling and precautions regarding collecting herptiles, followed by addresses for reporting unusual or rare species found within the Delmarva Peninsula.

Chapter 5 relates to conservation of the Delmarva herpetofauna with a short discussion on causes of amphibian and reptile declines, conservation and management, species of special concern, and an appendix for recording notes on species cited within the province.

This well-illustrated field guide size (185 x 44 cm) volume covers seventy-three species with each account containing a detailed description for the species, followed by comparisons of similar species, and information on the geographical distribution, reproduction and development, and comments on population declines. This volume contains 96 color plates centrally located within the text, and all are of unusual or excellent quality.

The bibliography has only one fault, as it fails to cite any references from the Catalogue of American Amphibians and Reptiles. Otherwise the authors cite 312 references, which is amazing considering the size of the territory involved.

*News and Notes*

This landmark field guide will certainly be a welcome addition to the literature, and will hopefully educate and stimulate younger generations to appreciate these awesome creatures. The price will certainly make it available to anyone interested in the herpetofauna of this area, and any other bibliomaniac friends.

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## Book Review

**Introduction to Horned Lizards of North America**, by Wade C. Sherbrooke, 2003. California Natural History guide Series Number 64, xiii +178 pp. Illus. with 164 color photographs. university of California Press, Berkeley. 0-520-22827-8 \$16.95 (paper), 0-520-22825-1 \$35.00 (cloth).

The author has published extensively on the Horned Lizards of North America, with his first major review appearing in 1981, and his PhD thesis on the Integumental Biology appearing seven years later.

This book is a concise introduction to the natural history and evolution of the horned lizards, and their impact on ancient Indian rock art through modern art. The book opens with a short historical sketch along with remarks on diversity of form in relationship to the environment. This is followed by a unique flow diagrammatical key for the identification of the 13 species found within Mexico, Southwestern North America and Canada.

The book is extremely well illustrated with photographs of each species, and habitat. This is followed with a short discussion of convergent evolution between the horned lizards of the New World family Iguanidae, and the Australian Thorny Devil (*Moloch horridus*) of the Old World lizard family Agamidae. This is well illustrated with photographs of both genera in defensive display, and feeding and drinking behavior.

The Natural History section covers the activity cycle, enemies, defense, reproduction and human impact, and is well illustrated with photographs on morning emergence, orientation to morning sun, burrowing behavior, removal of sand particles from nasal and eye areas, sleeping behavior, mimicry, color changes during thermoregulation and pigmentation. The physiological section is highly informative, with excellent photographs of cryptic coloration, defensive behavior (blood squirting), and predation. This is followed by an excellent chapter on reproduction. The last chapter relates to the horned lizard in relation to man. the cliff-dwelling Anasazi and Hohokam of the southwestern United States have numerous pottery artifacts illustrating the horned lizard design for the past 2000 years. this trend continues in stone and wood carvings and ceramic pottery of the Zuni Indians of modern times.

Overall, the book is extremely well written, and the major portion of the photographs are of high quality, although the plate on page 49 of *Phrynosoma solare*

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should have been taken with a flash to eliminate the dark backgrounds, and dull appearance.

The book is actually written in field guide fashion, as the author provides a selected reference section with 91 author citations, although none of these references are cited within the text. I would highly recommend this book to anyone interested in the saurology of North America, and the price is certainly reasonable.

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Errata:

In the last issue, Vol. 39, No. 3 on p. 52 the Received and Accepted dates were accidentally omitted and are as follows...

Received: 27 May 2003

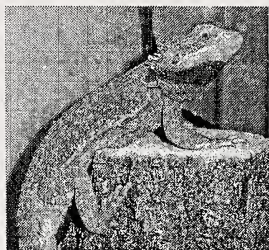
Accepted: 17 August 2003



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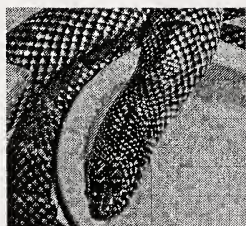
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## Society Publication

Back issues of the Bulletin of the Maryland Herpetological Society, where available, may be obtained by writing the Executive Editor. A list of available issues will be sent upon request. Individual numbers in stock are \$5.00 each, unless otherwise noted.

The Society also publishes a Newsletter on a somewhat irregular basis. These are distributed to the membership free of charge. Also published are Maryland Herpetofauna Leaflets and these are available at \$.25/page.

## Information for Authors

All correspondence should be addressed to the Executive Editor. Manuscripts being submitted for publication should be typewritten (double spaced) on good quality 8 1/2 by 11 inch paper with adequate margins. Submit original and first carbon, retaining the second carbon. If entered on a word processor, also submit diskette and note word processor and operating system used. Indicate where illustrations or photographs are to appear in text. Cite all literature used at end in alphabetical order by author.

Major papers are those over five pages (double spaced, elite type) and must include an abstract. The authors name should be centered under the title, and the address is to follow the Literature Cited. Minor papers are those papers with fewer than five pages. Author's name is to be placed at end of paper (see recent issue). For additional information see *Style Manual for Biological Journals* (1964), American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

Reprints are available at \$.07 a page and should be ordered when manuscripts are submitted or when proofs are returned. Minimum order is 100 reprints. Either edited manuscript or proof will be returned to author for approval or correction. The author will be responsible for all corrections to proof, and must return proof preferably within seven days.

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